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Erecting Additional Trusses by Cantilever Method
Columbia River Bridge near Wenatchee, Wash.

Reinforcing Columbia River Bridge of Great Northern Ry.—Building Paved Roads by Force Account in Michigan—River Control at New St. Louis Water Works—Tunnel Driving and Shaft Sinking in Slaking Rock—Army Engineers' Report on Navigation Requirements of Chicago Drainage Canal

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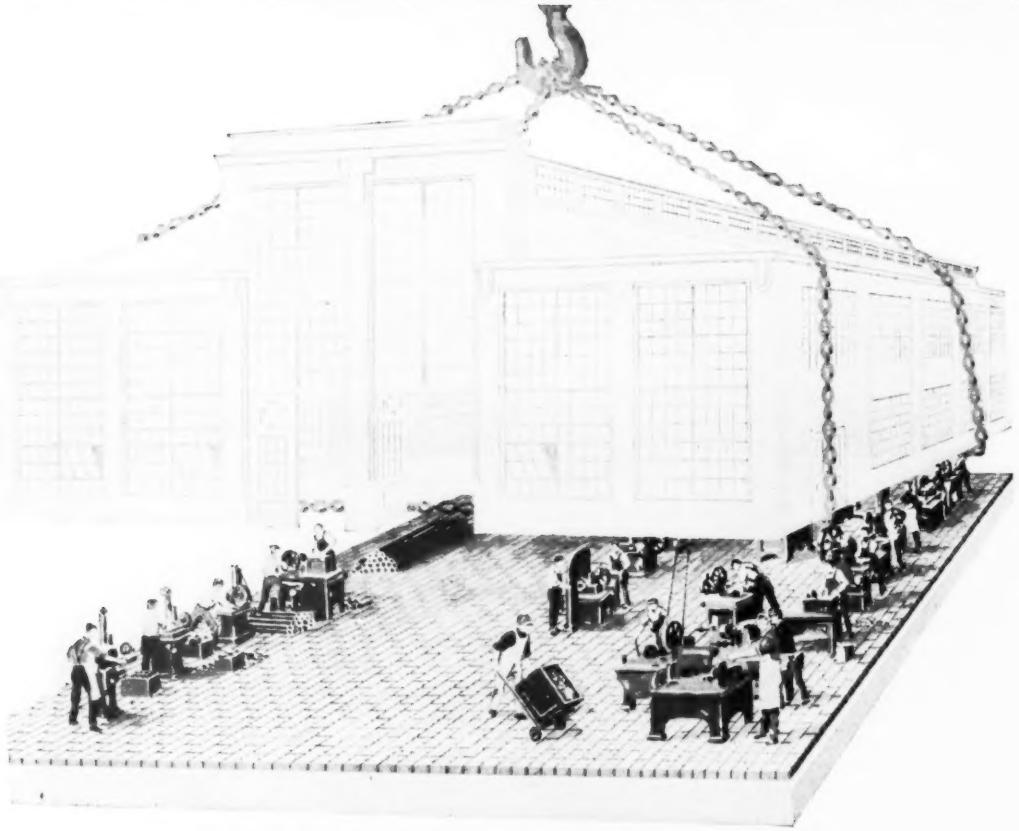

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Politics Before Policy

MAYOR MILLER, of St. Louis, has dismissed E. E. Wall from the office of director of public utilities after thirty-three years of devoted engineering service to his city. The motives of his action must have seemed to him to have been commanding, because he has by so doing imperiled his own security in office. But the formal steps that he took to get rid of Mr. Wall not only do not justify his action but cast the gravest doubts on its sincerity. It is being said in St. Louis that the mayor wanted his director of public utilities to get out because he would not co-operate with other members of the city administration, that he was arbitrary and irascible, that he did not, in short, show those executive qualities that are necessary to the head of a large city department. But the mayor did not choose to ask or to demand a resignation on those grounds. He put the case against Mr. Wall partly on some frivolous grounds which he himself later dismissed, but mainly on the director's refusal to replace a trusted engineering subordinate by a favorite of the mayor who had been dismissed. The issue that then confronted Mr. Wall is clearly stated in the city charter which says that the mayor is required "to exercise a general supervision over all the executive affairs of the city" and that the director is to "be influenced only by the consideration of fitness in the appointment, promotion, demotion, suspension or discharge of officers or employees." In thus upholding the technical department's control of technical matters the director was on firm ground, on much firmer ground than a mayor who had to resort to devious means to gain his ends. The mayor's friends say he is not a politician. His actions belie their claims. A mayor of a city has a right to sympathetic assistance from his department heads but he has no right to attempt to control the technical details of their administration. When he steps into that field he puts politics into that part of municipal government where efficiency and honesty demand that politics should be avoided.

Testing Pavement Smoothness

THE city of Washington has the reputation for fine, smooth street pavements. There the modern asphalt pavement had its earliest large development and there it receives perhaps its most public notice, for every citizen gets to Washington every so often and notes and comments on its streets. Those streets still look as fine and smooth as they ever did and to the ordinary trolley rider and automobilist they are just as satisfactory. But Washington, like most other cities, is seeing a great new development of the bus and the rider in these buses gets a different impression of the streets. Surfaces smooth and fair under the wheels of an automobile become bonerackers when a fully loaded bus travels over them at thirty miles an hour. Bumps show up where there were no bumps before and holes appear in apparently level surfaces. The city is complaining that Congress will not give it money for street improvement. The thing to do would be to load the House committee on the District of Columbia on a 40-passenger bus and run them up and down Vermont Ave. for a while. The moral is far reaching. The bus has apparently come to stay; but city officials and citizens in general had better begin to consider what its coming is going to mean in extra costs of paving, not only because it is itself a destroyer of road surface but because it is a detector of hitherto unsuspected irregularities.

New Object of River Control

RIVER control for a new purpose is being carried out by the city of St. Louis, Mo. In building a new water-works intake, the channel is being shifted to a course along shore in order to avoid the troubles and expense incident to the off-shore intake at Chain of Rocks. The dikes and the shore protection under construction for this purpose are described elsewhere in this issue. The project makes an interesting addition to the various means adopted by engineers to control the forces of nature for the benefit of man.

Water Out of Place

WATER is all right in its place but becomes dirt when added to milk by the connivance of dealers and health inspectors, as the new commissioner of health of New York City alleges has been done of late. Such dilution has more than economic significance. Besides reducing food values it may cause the spread of communicable diseases, for it is hardly to be expected that those who connive in milk dilution will be over particular in seeing that the diluting water is safe for consumption.

Experimenting With Contract Sureties

SOME weeks ago in commenting on a report on contract surety bonding by the state architect of New York we referred to that official as Mr. Sullivan. The gentleman's name is Jones—Sullivan W. Jones—and an apology is hereby offered him for that most unforgivable of offenses, the miscalling of one's name. It may be noted now that Mr. Jones' recommendations have borne fruit in a bill just introduced in the New York Legislature amending the public buildings law so that it will contain the following provisions: "All contracts in excess of five hundred dollars must be let by public bidding to the lowest reputable and reliable bidder. The words reputable and reliable bidder are defined and taken to mean that the bidder shall be able to show to the satisfaction of the state architect assets in excess of liabilities to the equivalent of fifteen per centum of the amount of the contract, or that a bank or trust company authorized to do business in the state of New York

will advance to him credit to that amount. And further, that the bidder shall show to the satisfaction of the state architect that he has successfully executed work of similar character and scope." This is a definite challenge to the corporate surety idea. It remains to be seen how it will be taken by the Legislature, but if it is enacted into law there will be a fine opportunity in New York to observe the working of one of the few plausible, though as the earlier editorial indicated possibly one of the most dangerous, expedients suggested to cure the obvious evils connected with contract bonding.

Chicago's Diversion Again

ANOTHER chapter in the long history of the Chicago diversion from the Great Lakes is added by the army engineers' reports just transmitted to Congress. These reports, which go through the customary army procedure of successive scrutiny and recommendation by officers of increasing rank, are primarily concerned with the navigation requirements and possibilities of the waterway link between the reversed Chicago River and the Illinois River, but in the study some of the questions in the more complicated Chicago diversion problem had to be answered. In the answering it is apparent that the army engineers are not in complete accord with the Engineering Board of Review, consisting of 28 civilian engineers, which reported to the Sanitary District of Chicago about sixteen months ago.

It will be remembered that the board of review stated that the lakes-to-gulf waterway while operable on a 1,000-sec.ft. flow required a 10,000-sec.ft. flow for the most economical combination of first cost and operation, and that, in respect to the treatment of Chicago sewage, even a treated sewage as far ahead as 1955 would require a 7,700-sec.ft. flow, for dilution alone.

On these two points the army report differs. That report makes a comparative study of the cost of construction and operation of the navigation canal under different volumes of inflow from the Lakes. It then concludes that the requirements of navigation will be economically met, all things considered, with an annual average diversion of 4,167 sec.ft. This is obviously a figure arbitrarily fixed because of the fact that there is in existence a long standing government permit for that amount of diversion, which may have a very decided influence in any international agreement as to the amount of flow permissible at Chicago. The army engineers would apparently be satisfied with 3,000 or 5,000; the point is that they do not consider that the navigation requirements justify any demand for 10,000 sec.ft., as did the board of review.

In regard to the sewage treatment requirements, the army engineers had the advice of one of the leading sanitary engineering firms in the country. This firm made an investigation which if paralleled by the board of review was not presented in its final report; that is, a comparison of the cost to the city of Chicago of sewage treatment under varying permissible diversions from the lake into the river. The conclusion is that while the gross average flow at Lockport cannot be reduced below 2,000 sec.ft. and at the same time maintain the pollution standard unimpaired, above that degree of dilution, the cost of treatment is in inverse proportion to the amount of dilution, so that with an annual average flow at Lockport of 10,000 sec.ft. the cost would be some $57,000,000 as against $69,000,000 for the 4,167-sec.ft. flow. Below that flow, however the problem of proper dilution would require either experimental extensions into sand filter treatment or disposal of the effluent far out into Lake Michigan beyond the reach of the water supply, and either of these two expedients would probably raise the cost beyond possibilities of attempt. Thus, according to the report of the army engineers and their consultants, instead of there being an absolute necessity for at least a 7,700-sec.ft. flow as the board of review reported, that necessity is measured merely by a difference in cost of some $8,000,000. We have in the army engineers' report a closer approximation to what might have been asked from the board of review, that is, not a defense of the demand for 10,000 sec.ft. at Chicago, but a comparative statement of what the varying degrees of diversion might mean in terms of the sanitary requirements of the Chicago district.

The army report recognizes the legal and diplomatic complications which lie in the Chicago diversion and does not presume to report on their full ramifications. It says it is unable to give its opinion as to what is the exact amount of diversion which would result in the maximum of benefit to the nation as a whole, taking all factors into account. But it does pass very definitely on two of the things on which up till now only the side of those arguing for the fullest diversion at Chicago has been presented. It does, too, have a tone of just regard for all of the interests concerned, both in the United States and Canada, which might well be emulated on the north side of the boundary. The Chicago diversion is an important international issue, the solution of which will in time be amicably settled. But that settlement is not being hastened by the consistently pugnacious attitude of Canadian politicians and press.

Government Rail Financing

HOW far shall the railroads be permitted to go in the control of their own financial destinies? Over that question the Interstate Commerce Commission is divided; the majority appearing to favor a very close control, while the minority proposes to let the railroad directors have complete freedom except in cases where it is evident to the commission that their plans are not in the public interest. The answer is of great importance, because upon it depends not only many construction and consolidation plans of the railroads, but also the extent to which the government is to take a hand in private business. If railroad companies are allowed to rearrange the financial structure of their railroads or that of controlled lines to suit themselves, the controlling interests can continue to raise money without losing control of the property in cases where the margin of control is slight, whereas, on the other hand, if their plans, while not actually contrary to the public interest, still do not agree with the commission's ideas as to the best method of dealing with the situation, the commission may force them to put in a large amount of money to continue in control by disapproving the plans.

The ordinary method of continuing control without putting large amounts of money into the property is by the sale of bonds or non-voting stock. Sales of both these types of securities have been dealt with by the commission in recent decisions which are, therefore, of more than passing importance. In one, the Pittsburgh & West Virginia Ry. was denied authority to issue

preferred stock with limited voting power and common stock of $50 par value. In the other decision, the Chesapeake & Ohio Ry. was denied authority to issue bonds to reimburse its treasury for improvements and the acquisition of control of a small railway. In the latter case, Commissioner Woodlock, while concurring with the majority on the merits of the individual case on the basis that the C. & O. is one of the few prosperous roads in the country that can sell its stock at or above par and consequently should not be allowed to load itself up with mortgages, disagrees with the majority in principle as he and Commissioner Taylor did in the case of the Pittsburgh & West Virginia when Commissioner Woodlock, in dissenting, said: "If we are to rely upon private enterprise and private capital for management of transportation, and if we are to rely upon voluntary enlistment of that capital, it is manifest that the utmost freedom of exchange should be provided for owners of that capital."

Following the same line of reasoning, in the C. & O. case he said: "So many of the activities of the railroad carriers are now directly subject to definite control by this commission that the zone of free action available to management is considerably circumscribed. That portion of the zone wherein lie questions of finance is perhaps the largest part of the whole. In my judgment, it is our duty to avoid entering upon that zone, save upon the clearest evidence of public necessity."

This appears to be the gist of the matter. The commission can hardly set itself up to be a financial superauthority to pass upon the details of each plan without accepting a larger measure of responsibility for its success than it can possibly take. It should be rather a watchman to see that nothing which is obviously not in the public interest is passed on to the public.

Day Labor Economy Not Proved

DAY-LABOR construction is not a prevalent practice in state highway building. It may be characterized as a method tabooed by all but a few state highway departments and the federal Bureau of Public Roads has expressed its disfavor of the principle. It commands interest then when a great road building state turns to the policy of building a considerable mileage of its highest type pavements by direct labor, acquires a large plant for road building, creates a great construction organization and even undertakes the manufacture of cement for its state road work. The questions extrude: How did the new practice come about? What has the road user got by the change?

An attempt has been made to answer these questions in the article in this issue on day-labor road construction in Michigan. One may not pretend that the answer is either precise or positive. In particular it is in no way quantitative. Costs are not given nor any definite measure of the quality of the product. In this respect the investigation is most unsatisfactory as a determination of the essential evils or advantages of day labor construction. It is not so much that there is concealment on the part of the state officials of facts that are necessary to any comparison as that the contributing factors to the day labor and the contract built roads are so different as to preclude comparison.

If, for instance, there were an exact measure of performance for a road, if one could grade the excellence of workmanship and the degree of wearability by some scale and if two exactly comparable roads were then built at the same time one by day labor and the other by contract, one could readily say that the state was saving or losing money by going into the road building business. But there is no gage of excellence, there are no two exactly comparable roads, there is no way of gaging the productiveness of convict labor, for humanitarian considerations govern that use as much as do economic ones. And finally in day labor work the overhead charges are matters of public accounting on which so far no exact rules have been laid down.

So this article on Michigan day labor work does not prove that the roads so built cost more or less than do those built by contract. It does not indicate what has been gained by the new policy in that state. It does not tell whether the state is getting a better product or if there has been a gain in speed of building. It does not reveal whether any evil conditions in road contracting in Michigan have been improved or cured. And it does not tell those things because there was no way found of discovering the facts regarding them. From such of the records as could be found there seemed always to be found for every opinion and fact on one side a counterbalancing opinion or fact on the other.

This is admittedly about as ineffectual a condition as can surround a serious problem. But it is not peculiar to the Michigan day labor work. It applies to almost every extensive day labor operation that is examined. Theoretically all of the arguments are against day labor work. The only thing that could be said in its favor is that it gets the work done for less cost. If that could be proved in any specific case, the general argument would have to fall, for after all the government, which is the people, is entitled to get its work done as cheaply as possible. But in few cases can the advocates of the day labor system prove economy, and as the burden of proof is on them so far the general case is against them. When it comes to specific cases, however, the study generally results as in Michigan—the confusion of accounting, the variability of planning and the absence of comparability are such that no one really knows whether the state got more or less for its money by this system than by normal contracting.

But because the principle in general is wrong no public body should enter into day work without the fullest preparation for a defense of the policy. The most exact and complete accounting should be undertaken, every possible element of overhead should be considered, the extensions of construction beyond design should be itemized, comparability with similar contract work should be sought rather than avoided. By this means only can day labor work be justified. If with every item of cost accounted for the public official can show that he is saving the people money, then those who are afraid that day labor is tending toward socialism will be put upon the defensive, for the only lasting argument against socialism is that it is destructive of both economy and efficiency. As a term of opprobrium merely to wave around it can scare nobody who thinks. As a condition which will make us all work harder to accomplish less results it is a dangerous possibility.

The Michigan road situation is important, then, because it shows that the officials who are indulging largely in day labor work for roads there do not really know whether it is an improvement or not. Until or unless they can show that, they are deceiving the people of the state.

Reinforcing Columbia River Bridge of Great Northern Ry.

Strength of Large Steel Railway Bridge Increased 100 Per Cent—Cantilever Erection of 416½-Ft. Span —Anchor Spans Re-used—Erection Controlled by Strain Gages

By H. S. Loeffler
Assistant Engineer, Great Northern Railway Co., St. Paul, Minn.

During the last few years the Great Northern Railway Co. has strengthened a number of its largest steel bridges. One of the most interesting of these operations has just been completed, the strengthening of the Columbia River bridge by an unusual and effective method. The old structure, being in excellent condition, is retained practically intact. After the completion of the reinforcement the resulting structure has double the strength of the original bridge.

Original Structure—The main line of the Great Northern crosses the Columbia River ten miles east of Wenatchee, Wash. The river here flows in a solid rock channel 600 ft. in width, and the depth of water in the deepest part is about 150 ft.

Here the Columbia was spanned by a steel bridge consisting of a 250-ft. pin-connected deck-truss span and a 416½-ft. pin-connected through-truss span, built during the winter of 1892-1893, and a steel trestle approach 210 ft. in length added a few years later. This, the original bridge, was supported on concrete and masonry piers resting on solid rock foundations. On a rock island, about 200 ft. from the east shore, was constructed a masonry pier carrying a steel A-frame which supported the adjacent ends of the two truss spans. The west end of the 416½-ft. span was supported on a steel rocker bent.

The original structure was designed to carry two 122-ton locomotives, double-headed, followed by a uniform train load of 4,000 lb. per lin.ft., equivalent to Cooper's E-35 loading.

During recent years all trains were required to operate at reduced speed over this light structure, and the heavy types of locomotives which were in service on other parts of the Great Northern System were prohibited from crossing the bridge. In order to eliminate these slow orders and to permit the operation of heavier power, the entire bridge has been reinforced, as described in this article.

Reinforcement of Main Span—The 416½-ft. span has now been strengthened by the addition of another steel span, the trusses of which are identical in design with the trusses of the old span, except for some changes in the end panels and some improvements in details. The trusses of this new span are located in a plane 5 ft. outside of the old trusses, and the chords of the new span are located 8 ft. below the similar chords of the old span, the new floorbeams passing under the old floorbeams. The new span is provided with portal bracing and top and bottom lateral systems, as well as with transverse bracing between the vertical posts at each panel point. In order to eliminate interference between the two spans during erection, a 2-in. clearance was provided between the new transverse bracing and the vertical posts of the old span.

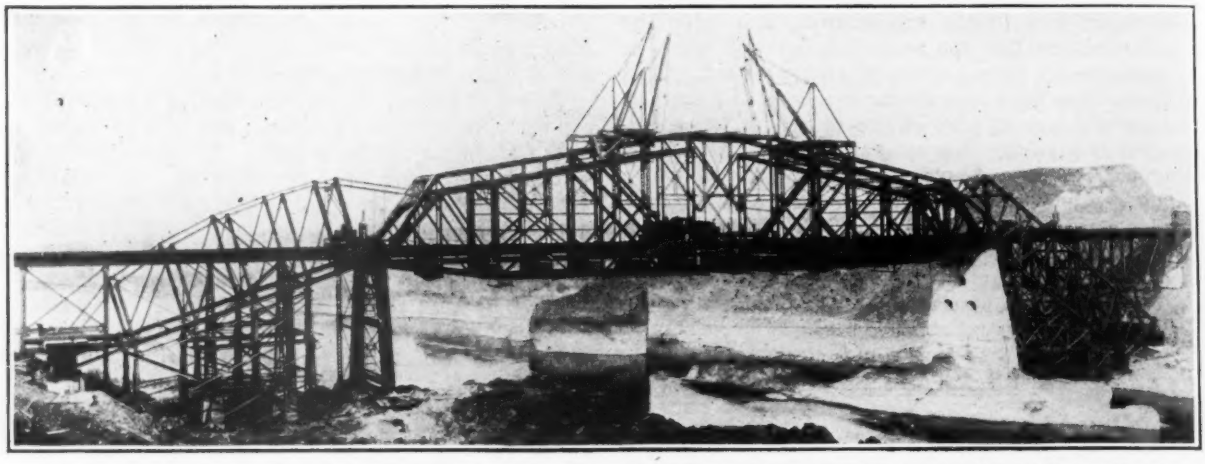


FIG. 1—ERECTING ADDITIONAL TRUSSES OF MAIN SPAN, COLUMBIA RIVER BRIDGE OF GREAT NORTHERN RY.

The floorbeams of the new span were designed for Cooper's E-35 loading. The new floorbeams are braced by struts longitudinal to the bridge and connected to the lower laterals at their intersections.

The old steel A-frame, previously mentioned, which supports the adjacent ends of the two old spans, has been encased in concrete. This new concrete pier is constructed of sufficient width at the top to accommodate the bearings for the east end of the new 416½-ft. span. The west end of this span is supported on a new steel rocker bent, the columns of which are parallel to the columns of the old rocker bent. Clearance of 3 in. was provided between the old rocker bent and the transverse bracing of the new rocker bent to prevent interference during erection.

Erection by Cantilever Method—The erection of the new 416½-ft. span was accomplished by the cantilever method, the only method practicable on account of the depth of water in the main channel and the fact that the old span was not strong enough to support the new span during erection in addition to carrying trains.

In order to reduce to a minimum the amount of

falsework steel required for erection purposes only, the major portion of the two anchor spans was built of steel trusses which were recovered and re-used after they had served their purpose as anchor spans. Anchor span *A*, at the east end, consisted of part of a 252-ft. riveted skew span which after being recovered was re-erected near Skykomish, Washington. Anchor span *B*, at the west end, consisted of a 250-ft. pin-connected truss erected in two parts to form a 125-ft. anchor span; this span was later dismantled, taken across the river to the east side, and placed as a center truss to strengthen the 250-ft. deck span adjacent to the 416½ ft. the anchor spans on the top of the falsework bents, structural steel bearing brackets were provided.

The dead-load of the anchor spans was not sufficient to counterbalance the cantilever arms. Counterweight boxes were therefore provided at the outer ends of the anchor spans; they were built of standard 40-ft. plate-girder spans provided with diaphragms for connecting the girders to the trusses of the anchor spans (these girder spans were later recovered and re-used), fitted with timber floor and filled with gravel. The additional counterweight load required consisted of steel rails stacked on top of the girders. An excess of 112,000 lb.

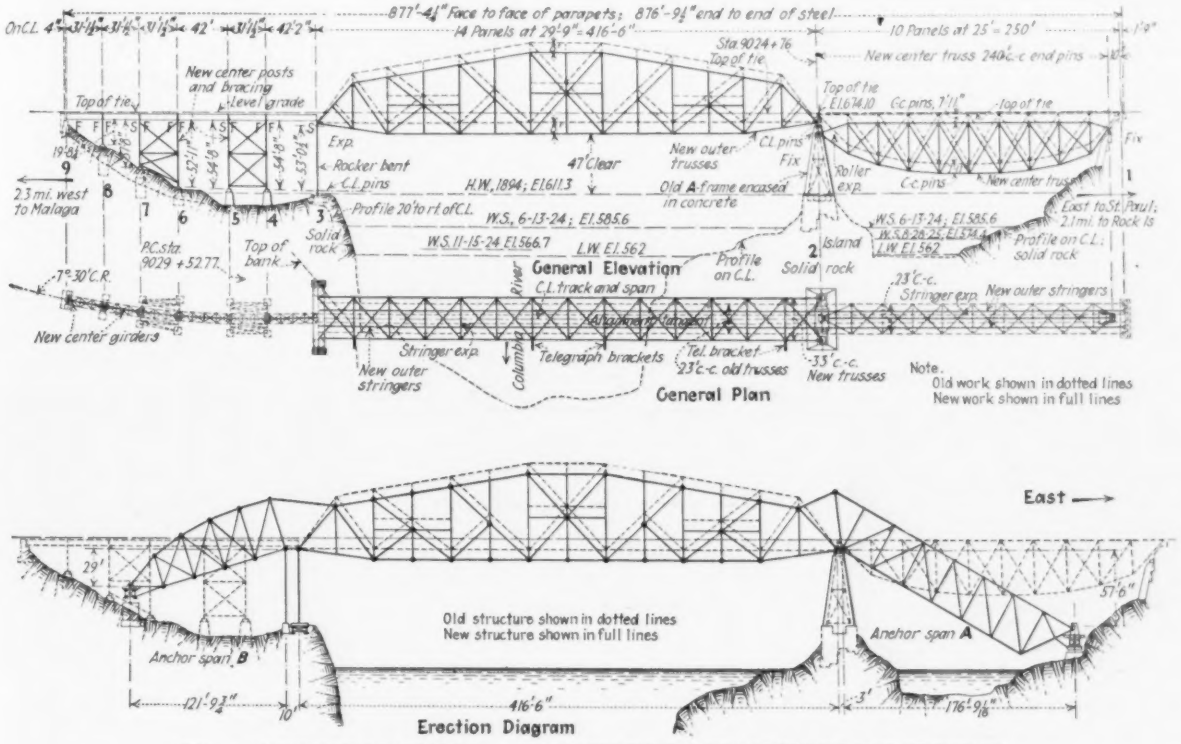


FIG. 2—REINFORCED BRIDGE, AND CANTILEVER ARRANGEMENT FOR ERECTION

span. Both anchor spans were provided with lateral systems consisting of steel lateral bracing and timber cross struts. Steel cables were placed at several panel points to brace the anchor spans transversely.

Anchor Span Erection—Timber falsework was placed for the erection of the anchor spans. The falsework for the west anchor span was constructed on the west bank above the water level. The rock bottom in the channel under the east anchor span is quite irregular, and at the time the falsework was placed in this channel there was seventeen feet of swiftly running water, so that it was necessary to anchor each bent with a cable as the bent was lowered into the stream. The lower bents were designed with four 12x12 in. posts 36 ft. long, set directly on the rock (bottom sills omitted). To insure proper bearing of all four posts of a bent on the irregular rock surface these bents were first framed with the two outside posts only and were lowered into place and plumbed before the two inside posts were set. After all four posts were in place the tops of the posts were cut off to the proper level and the caps placed.

To obtain a level bearing of the inclined chords of over the actual calculated amount of rail was placed on each of the counterweights.

The anchor spans and the first two panels at each end of the 416½-ft. span were erected with locomotive cranes, one 30-ton crane and one 60-ton crane being used. The rest of the 416½-ft. span was erected by means of two 12-ton steel travelers, each equipped with two 65-ft. booms. These travelers were mounted on a timber frame supported on and anchored to the top chords of the new span. The four hoisting engines used in connection with the travelers were placed near track level. The new structural steel was loaded on flat cars in the storage yard and moved to the bridge with a lightweight locomotive. The travelers handled the steel from the flat cars up through the top of the old span and landed the steel in place in the new trusses.

Provision for Adjustment—Four 300-ton hydraulic jacks were used at the outer end of each anchor span for vertical adjustment of the two cantilever arms; the jacks were located at the ends of the counterweight girders. In addition to this a screw adjustment was provided at the west end of the west anchor span for

the purpose of moving the west anchor arm and the west cantilever arm endwise for final closure.

Strain gages of special design were placed on the eyebar links connecting the anchor spans to the cantilever arms. Observations were made on these gages during the jacking of the counterweights and during the passage of trains to determine the stresses developed in these members due to friction between the cantilever arms and the old 416½-ft. span.

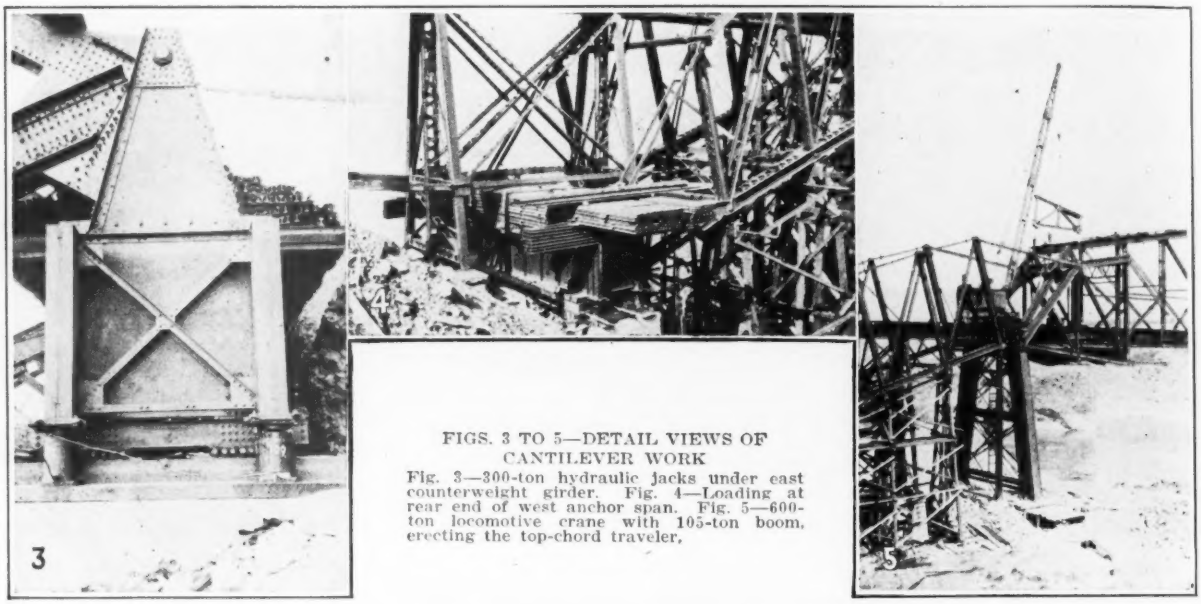
After the new span was swung to carry its own dead-load, and all truss splices had been riveted, steel shims were placed at each panel point between the bottom of the old chords and the top of the new floorbeams. These shims were adjusted to a snug fit without excessive driving. Observations were made with a Berry strain gage on the lower chords of both the old and the new spans before and after placing the shims in order to be certain that the shims were not driven too tight, which, of course, would have resulted in transferring too much dead-load to the new span.

Steel struts connecting the new floorbeams to the old floorbeams were then placed, and field holes drilled through the webs of the old floorbeams to match the shop holes in the struts. Also, the steel struts between the vertical posts of the old and the new trusses were placed at this time, and all connections made between the new transverse bracing and the old vertical posts.

There were four stringers in the old span; two main stringers and two safety stringers. The two main stringers had a capacity of Cooper's E-35 loading. The safety stringers were replaced with new stringers which were identical in design with the old main stringers, and the four stringers connected by steel-plate diaphragms, three of the diaphragms being used for each panel.

Reinforcement of 250-ft. Span—The 250-ft. span was strengthened by the addition of a center truss. As previously mentioned, this truss was used for the west anchor span for the cantilever erection of the 416½-ft. span. It is of the same dimensions as the trusses of the old span except in the end panels, which had to be altered to fit the foundations. The allowable loading on the old 250-ft. span is Coopers E-35, and the new center truss was designed to carry the same loading in addition to its own dead-load. Thus the span after reinforcement is capable of carrying Cooper's E-70 loading. The new center truss was set 7 ft. 11 in. lower than the old trusses to allow the top chord of the new truss to clear the old floorbeams.

During erection the new center truss was supported on timber falsework. When it was swung, steel shims were placed at each panel point between the bottom of the old floorbeams and the top of the new top chord, and connections were then made to the new transverse bracing (below the floorbeams) and the cross struts. The floor system was reinforced in a manner similar to the reinforcement of the floor system of the main span.



FIGS. 3 TO 5—DETAIL VIEWS OF CANTILEVER WORK

Fig. 3—300-ton hydraulic jacks under east counterweight girder. Fig. 4—Loading at rear end of west anchor span. Fig. 5—600-ton locomotive crane with 105-ton boom, erecting the top-chord traveler.

Reinforcement of Trestle Approach—The steel approach at the west end of the structure has been reinforced by the addition of girders and columns along the center line of the bridge, the reinforcement being designed for Cooper's E-35 loading. The new center girders are the same depth as the old girders. New cross-frames and new lateral bracing were provided throughout.

Design and Quantities—The A.R.E.A. specifications were used throughout for the design of the structural

FIG. 6—REINFORCED BRIDGE AFTER COMPLETION OF WORK

steel. The amount of material used in the reconstruction work is:

Concrete in substructure	1,935 cu.yd.
Steel reinforcing bars in substructure	8 tons
Structural Steel	
West Approach, including rocker bent 3	190 tons
New 416½-ft. span and repairs to old 416½-ft. span	940 tons
New 240-ft. center truss and repairs to old 250-ft. span	240 tons
Falsework*	440 tons
Total structural steel	1,810 tons

*Note—Of the 440 tons of structural steel used as falsework 228 tons was recovered as new value (to be re-used) and 152 tons was recovered as scrap.

The estimated total cost of the reconstruction is $400,000.

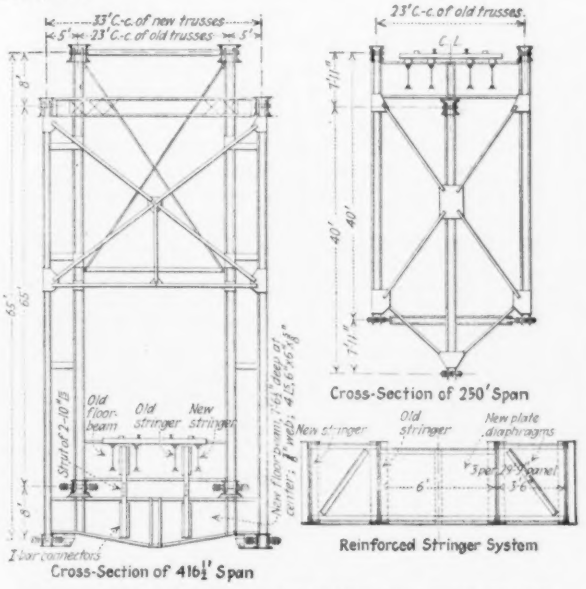


FIG. 7—CROSS-SECTIONS OF MAIN AND SIDE SPANS AS REINFORCED

Personnel—The following Great Northern engineers have been actively connected with the work: A. H. Hogeland, consulting engineer; J. R. W. Davis, chief engineer; John A. Bohland, bridge engineer. The author was engineer in charge, and was responsible for the method of reinforcement. Ralph Modjeski, consulting engineer, has been consulted on several occasions in regard to certain features of the design and construction. The American Bridge Co. fabricated the structural steel and carried out the erection work under contract, with E. J. McGivena as superintendent of construction and A. C. Beckman as field engineer.

Erection of the superstructure was started May 20, 1925; closure of the 416½-ft. span was made Oct. 27; and the entire reinforcement was completed by Jan. 1, 1926.

1925 Tourists Business in Wisconsin $100,000,000

An average of 9,000 touring cars entered Wisconsin daily during a traffic count taken at the state line between July 3 and Aug. 20. From these figures and from questionnaires handed to thousands of tourists during the summer season, J. T. Donaghey reports 990,000 foreign cars entered the state during the 110-day tourist season. They carried an average of 3.56 passengers and spent $85.30 per car, stayed in the state 8½ days and traveled 586 miles. Adding the rail passenger traffic the tourist crop is estimated at $100,000,000 during 1925, more than one-third of the dairy business of the state.

Porosity of Reservoir Prevents Water Storage

GROUTING has been recommended as the best means of stopping excessive leakage in the Malad reservoir near Malad, Idaho, by Harold T. Stearns, geologist, in a recent report to the United States Geological Survey. The dam is a multiple-arch structure designed for a height of 70 ft. and a length of 440 ft. Its construction was under way in 1917-18 but was stopped when the dam reached a height of 50 ft. due to excessive leakage observed at that time, and has never been finished. The following is taken from Mr. Stearns' report:

When the gates of this dam were closed and the reservoir filled to the 10-ft. contour, the water level rose no higher on account of the leakage. Even with a continuous flow of 25 sec.-ft. the entire flow disappeared into a talus slope on the southwest side of the reservoir about 1,200 ft. north of the dam. Doubtless if the reservoir could have been filled to higher levels the rate of leakage would have been greater.

Shafts were sunk and extensive studies were made of underground water conditions in the reservoir. The water-table map indicated that practically the entire underground flow sank in the locality of the talus slope mentioned and then disappeared in the limestone underneath within an area encircled by the 60-ft. ground-water contour.

The probable cause is a bed of soluble limestone in which water escapes along bedding planes widened by solution. The maximum area of leakage is probably not more than 500 ft. long and 25 ft. wide and probably the area in which the larger amount of leakage takes place is even smaller.

Various methods of repair previously suggested, involving vertical cutoff walls or puddled clay blankets, were not favored by Mr. Stearns who proposed instead a scheme of grouting. His plan would involve drilling holes perhaps 3 in. in diameter to determine precisely the area of leakage by forcing water down under pressure and later using the same holes for grout, these holes to be cased to the limestone bedrock and the casing driven 6 to 12 in. into it to prevent escape of water into the gravel above the rock during the tests.

The following is quoted from that part of the report commenting on the recommended method of repair:

A line of staggered holes should be drilled longitudinally 5 ft. apart into the zone of leakage. The open character of the fissures will require a drier mix than is usually used for grouting and doubtless considerable coarse sand can be used with the cement. The most economical mixture will have to be determined by experiment. The grout should be forced down by a hand pump or with low pressures, for the success of the grouting will depend not upon filling the fissures for their entire depth but upon filling them for the first 10 or 20 ft. below their intake area.

Thin cement mixtures and high pressures would probably mean failure, for the fissures probably extend many thousands of feet. Frequently it is found practical to grout with one mixture of cement and allow it to set. Later, a more liquid grout can be forced down, thereby filling the smaller crevices. Thus a dam would be made in the fissured limestone to prevent the water from sinking.

The advantage of grouting over all other methods is that after one line of grout holes had been grouted it would be feasible to close the gates in the dam and see what measure of success had been obtained. If the water rose higher than before grouting was commenced, a second line of grout holes could be drilled and more grout added. In this way, the success of the grouting could be tested before any great amount of money had been expended.

Plotting a Life Line for Tacoma's Water Supply Conduit

Schedule of Renewals on 40-Mile Wood-Stave Pipe Simplified by Use of Profile on Which Estimated Life is Plotted

By W. A. Kunigk
Superintendent and Engineer, Tacoma Water Works, Tacoma, Wash.

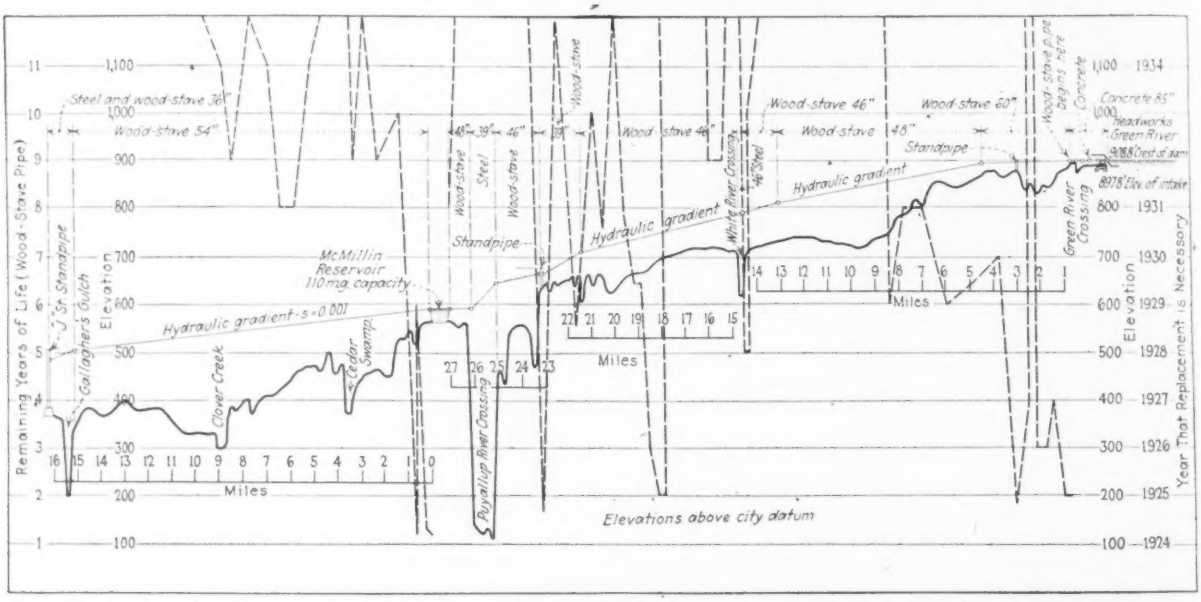
THE city of Tacoma, Wash., obtains its principal source of water supply from Green River, through a single 42-m.g.d. conduit 42.94 miles long. This conduit, completed and placed in service early in 1913, is made up of 0.58 mile of concrete-lined tunnels and 85-in. concrete pipe, 1.47 miles of riveted steel pipe, 39 to 46 in. diameter, and 40.89 miles of continuous wood-stave pipe ranging from 36 to 60 in. in diameter.

After seven years of service, or about the year 1920, trouble started to develop in the continuous stave pipe at widely separated points, and toward the end of 1922 it became apparent that it would be impossible to maintain some portions of the line much longer. With a limited storage capacity in town and an auxiliary supply system of less than half the mean daily consumption, the problem of maintaining service through a single supply line and at the same time making repairs thereto became serious. The solution was worked out as described in the following.

All stave lumber for the wooden pipe had been milled from 2x6-in. stock making a finished stave 1⅝ in. thick, except the staves for 0.83 miles of 36-in. pipe which operates under a normal head of over 200 ft., and for which finished staves 2 in. thick had been used. The lumber specifications had called for staves made of Washington yellow fir, perfectly sound, straight grained, entirely free from all knots, dry rot, cracks, checks or other defects that might impair their strength or durability. Lumber could be either air or kiln dried. Sap wood was permitted only on the inside of the staves extending not more than half way through the stave at any point. Small pitch pockets were permitted where they did not extend more than half way through the stave.

All bands were made up of ⅞-in. round mild steel provided with cold roll threads. For pipe up to and including 54-in. diameter the bands were made in one piece and for the 60-in. diameter pipe in two pieces. The maximum permissible spacing was 12 in. on centers with 8 in. maximum over the butt ends of the staves. The band spacing was computed by the formula $S = \frac{AT}{FR(0.434H)}$ in which S is the band spacing in inches, A is the effective area of the band, T is the ultimate tensile strength of the band steel in pounds per square inch, F is the safety factor (4, in this case), R is the radius of the pipe in inches and H is the head in feet. The pipe had been laid in trench and, except for bridges and trestles, backfilled for the entire length.

In the early part of 1923 the writer made a comprehensive and systematic study of the situation in order to ascertain, if possible, the underlying causes or conditions of the early decay and short-lived usefulness of some portions of the wood-stave pipe while other parts of the line seemed to be in excellent condition. It was decided to put down a sufficient number of test pits to ascertain the actual physical condition of the staves and bands.



TACOMA SUPPLY PIPE PROFILE WITH LINE SHOWING ESTIMATED LIFE IN DIFFERENT SECTIONS

The spacing of the test pits ranged from 200 or 300 ft. up to about 5,000 ft. and an accurate record was made of conditions disclosed by each hole. Wherever the change in the condition of the pipe between consecutive pits was found to be great, intermediate holes were put down. The record at each hole included station, date of examination, normal head at that particular point, diameter of the pipe, thickness of stave used, band spacing, maximum depth of decayed wood as ascertained by prodding with a pocket knife, estimate of the remaining years of useful life of the staves and also of the bands, nature of the soil conditions and depth of backfill. Further, under a column of remarks, notes were made regarding any conditions that might have a bearing on the life of the wooden staves and

bands or regarding other data that might be useful in preparing cost estimates for the reconstruction of the pipe line.

After studying the information so assembled, it became apparent that in different locations there were certain well defined causes responsible for the early decay of the wood staves. The order of importance of these conditions as they affect the life of the staves is about as follows: (1) Insufficient pressure to saturate the staves thoroughly has without doubt caused more decayed staves than any other one condition; (2) carelessness when backfilling in not keeping surface soil or decaying roots, wood or vegetable mold away from the pipe came next; (3) insufficient depth of backfill has in many cases hastened the deterioration of the upper half of the line; (4) in every case where pipe was built in made ground the staves were found decayed all the way through; (5) sap lumber was to blame for many bad isolated decayed staves, causing many blowouts in sections of the pipe which were otherwise found in good condition; (6) very rich, loamy soil, especially where dry, has had a bad effect on the staves; and finally (7) in the proximity of coal veins there appears to be an acid condition in the soil which shortens the life of the staves.

Aside from the trouble originating from decayed staves in the operation of this pipe line, the following defects were noted that could readily be overcome in future wood-pipe installations: (1) the 1⅝-in. thickness of staves used for the 54 and 60-in. pipes proved to be altogether too light for these diameters; (2) the 60-in. diameter pipe especially was found to be flattened as much as 9 in. from a backfill of less than 3 ft.; (3) in the 54-in. pipe where the head is in places over 200 ft., it was found difficult to make repairs to defective staves under such pressures; (4) carelessness in not removing all building blocks from underneath the pipe during construction has been responsible for some of the bottom staves buckling inward and breaking; (5) more attention to cradling with proper material would also have prevented some broken staves, and (6) butt ends of staves that were not driven home have been to blame for many small leaks in the line. The conclusions that may be drawn from this experience are self-evident.

With all of this information regarding the physical condition of the pipe line on hand in the shape of field notes taken over a distance of nearly 42 miles, the problem was to reduce these notes to such shape that an intelligent reconstruction program could be worked out. A flow line profile of the pipe line was therefore plotted to a horizontal scale of 2 miles to the inch and a vertical scale of 100 ft. to the inch. The hydraulic grade was next plotted on this profile. Then from the field notes giving the estimated life of each section of pipe a life line was indicated on the same profile as shown in the accompanying drawing. With this graphic illustration as to the life expectancy of every mile of pipe the matter of working out a tentative annual reconstruction program was much simplified.

A little study of this diagram strikingly illustrates the fact that wherever soil conditions can be left out of consideration a head of at least 60 ft. is necessary to produce the saturation necessary for preserving staves of 1⅝-in. thickness. For illustration, soil conditions were the determining factor in the life of the pipe between mile posts 15 and 19 below the headworks. Between mile posts 15 and 18 the ground is very wet and swampy during the whole year and the life line indicates a life expectancy of from 9 to 12 years, in spite of the fact that the head is only from 50 to 75 ft. Between mile posts 18 and 19, on the other hand, where pressure conditions are somewhat lighter and the soil consists of a dry, sandy loam, the life line indicates a life expectancy of only from 2 to 6 years, approximately. A large percentage of the wooden pipe line is still in an excellent state of preservation and will continue to give service for years to come as indicated on the diagram.

With this diagram as a guide an annual reconstruction program was worked out for each year until the pipe line will be completely rebuilt. Estimates were prepared for treated wood, steel and concrete pipe. Further estimates were also prepared for the corresponding period of the reconstruction program covering the maintenance or reconstruction, respectively, of all the appurtenant equipment of the Green River gravity system such as the intake works, tunnels, bridges, river protection works, trestles, railroad and highway crossings, culverts, the McMillin reservoir, etc. As many other improvements were contemplated in the water department beside the gravity system, involving expenditures of large sums of money, it was deemed advisable to make an inquiry also into the financial ability of the water department to take care of these improvements. Therefore a résumé was prepared showing a summary of all outstanding bond obligations, including interest and redemption, an estimate of the annual operation and maintenance expenses, the depreciation fund to be set aside for reconstruction, the amounts estimated necessary for gravity pipe line reconstruction, the moneys available for the distribution system reconstruction and extensions and the probable gross revenues.

As a basis for forecasting future revenues three graphic diagrams were prepared. The first diagram showed the growth of Tacoma's population taken from United States Census Bureau figures. The second diagram indicates the increase in annual number of service connections and the third one illustrates the annual increment in the past gross revenues. With this information as a guide, the writer worked out a tentative program which is helpful in laying out from year to year a constructive plan covering all of the operations of the water department, which is within the scope of the department's financial ability.

Blasting Helps Settle Swamp Fills

"In connection with meadow embankment, particularly across salt meadows, where an underlying crust is generally to be expected, the placement of the embankment and settlement can be greatly assisted if just prior to placing the fill the entire area on which the embankment is to be placed is broken up by dynamiting. In that manner the fill is permitted more readily and quickly to settle to a firm bottom. This operation can also be assisted by either excavating or dynamiting a ditch alongside the presumed toe of the embankment so as to permit the squeezing out of the under-strata without causing undue heaving of the surrounding meadow land outside the right of way line."—C. F. Bedwell, construction engineer, New Jersey State Highway Department.

Building Paved Road by Force Account in Michigan

Convict and Free Labor Worked Together—Plant Capable of Building 100 Miles Annually Is Owned by State—State Officials Consider Experiment Justified by Operations to Date

(Engineering News-Record Staff Article)

ABOUT 90 miles of paved road were constructed by day labor in Michigan in 1924. In 1925 65 miles were completed or put under construction by state forces. Combined with force account is the utilization of convict labor sometimes by itself but more generally in combination with free labor. The development of this state activity has occurred since 1923. The state has now the organization and equipment to build annually 100 miles of concrete road and 15 to 20 miles of asphalt road. It has leased and operates a cement mill.

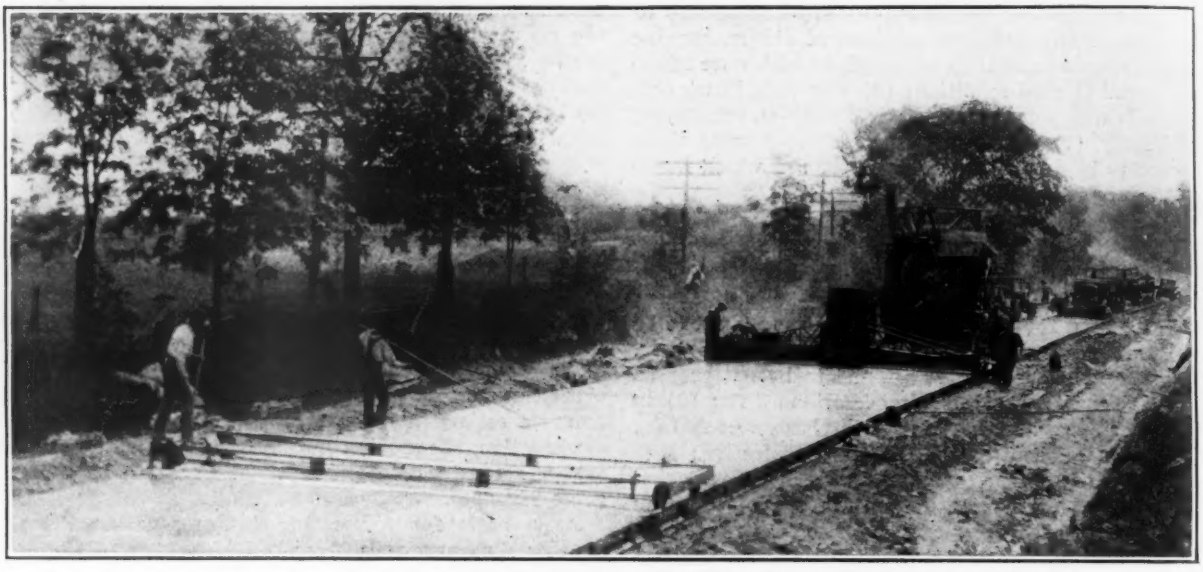


FIG. 1—STATE ROADBUILDING OUTFIT WITH TRUCK HAULAGE
Construction of 20-ft. pavement, showing roller on subgrade, trucks loaded with aggregate lined up in front of the mixer, turntable, mixer, finishing machine and final finishing.

Altogether its operations represent perhaps the most extensive effort made by any state to do its own paved-road construction. Their nature and the results obtained make a story of deep significance.

Genesis of Day Labor—Force account road construction as a purposeful state practice began in 1923. It had been employed previously by a number of counties in building county roads under older road laws, but at no time had county road building by force account been general—the greater part of all construction was by contract. This is true of present state practice. In 1924 there were built 849.6 miles of all types; of this mileage 471.3 miles were paved roads. The state constructed by force account only 90 miles—all paved road. All other construction was by contract, and previously all trunk line and federal-aid road had been contracted.

Day labor road work grew directly out of the 1922-23 session of the legislature. At this session the state association of contractors sought special legislation in a manner which antagonized the governor, the legislature and the state highway department. The governor became determined to free his hands from contract construction.

A state construction division was added to the highway department and was made free largely of control by the department engineers. The governor appointed its head. With his decision to build roads by direct labor the governor turned toward convict labor and its first use was in July, 1923, on a trunk line from Flint to the Oakland County line, 8.75 miles. This road had been paved by Genesee County and had gone to pieces. Bids for new construction were asked and none were received. To get the road pushed through, force account and convict labor were adopted; the work was finished before winter. With the inaugural undertaking, state forces were put onto other projects and by the end of 1923 state day-labor road work was in full swing.

Materials and Plant—With day-labor construction came the necessity of equipment and materials supply. A materials and equipment division was added to the department organization, and through it plant purchases and materials supply were taken up. As stated, the plant created has capacity to build annually 100 miles of concrete road and 15 to 20 miles of asphalt. As indicating investment for day-labor road work a summary of main equipment items is important.

An asphalt road-building plant comprises a semi-portable plant, with asphalt kettles, boilers, pumps and storage tanks; a fleet of motor trucks and a full outfit of tool furnaces, rollers, forms and other tools for asphalt paving. More complete accounts of the asphalt road plant were given in an article on surfacing gravel roads with asphalt, in *Engineering News-Record*, Jan. 7, 1926, p. 14.

For concrete road building there are twelve outfits complete with 21-E pavers, subgrade rollers, subgraders, finishing machines, float bridges, pumps, water pipe, steel forms and tools. A paving outfit with truck haulage is shown by Fig. 1, and Fig. 2 shows the truck

outfit in more detail. The loading equipment includes 5 industrial cranes, 14 steel loading bins, tunnel with traps, and several miles of standard-gage track-rails, ties, switches, etc. A loading plant is shown by Fig. 3, which also shows industrial railway hauling. Altogether there are 20 miles of narrow-gage track, 16 flat cars, 450 cars with batch boxes and 25 gasoline locomotives. Fig. 4 shows train taking its cement batches.

The grading equipment consists of 8 steam shovels, 25 dump wagons, graders, scarifiers, tractors, scrapers, plows, rollers and several small mixers for culvert work. A grading unit at work is shown by Fig. 5. For larger bridge construction there are two steel towers with chutes, Fig. 6, piledriver, mixers, pumps, pipe, steel sheeting, air compressor, salamanders, concrete buggies and tools. Camp equipment comprises portable buildings, bath houses, repair shops, lighting plants, water tanks, pumps, boilers and kitchen equipment.

No attempt has been made to inventory the equipment for state construction but its main units have been listed. State plant for construction represents an investment in round figures of $1,000,000. This plant is all being depreciated, and rental charged, as recommended by the Associated General Contractors.

Except for cement, state construction is depending for materials on the general market—buying as a contractor would buy. Cement since 1922 has been contracted for in quantity needed for each season's work and furnished to contractors at the nearest railway station. Buying early in the season and in volume a price advantage is gained. In 1923 the state started cement manufacture. Early in the summer of 1923 there was a fire at the plant of the Huron Portland Cement Co. at Alpena, which was the largest plant in the state, which eliminated this source of supply during the several months at the height of construction operations. In general, the other mills co-operated with the state in taking care of projects which were under way, but in several cases it was necessary to pay a premium for cement in order to complete important projects in 1923. That year the state leased the plant of the Michigan Portland Cement Co. at Chelsea, Mich., and beginning with Dec. 1, 1923, this plant has been operated with prison labor as one of the Michigan Prison Industries. The fact that the state has had this plant as a reserve source of supply is considered by the state officials to have been reflected in the prices and terms of the contracts made with the privately owned mills for 1924 and 1925 cement requirements.

Road Building Methods—All concrete roads built by direct labor, with minor exceptions, are of the latest standard shown by Fig. 7. Width is the outstanding point of this design. The pavement is 20 ft. and the total roadway is 36 ft. wide. Coincident with this wide roadway there has been carried out right-of-way widening. The nominal standard width is 100 ft., but in some instances this has to be narrowed and in special instances a greater width is provided. To date, wide right-of-way has been provided on some 400 miles—the narrowest 86 ft. and the widest 200 ft. but the most of it 100 ft. The cost varies with local property values but has averaged 3.2 per cent of the construction cost.

In slab design a good thickness is being maintained

FIG. 2—CLOSE-UP OF TRUCK HAULAGE OUTFIT
Large trucks with partitioned bodies carrying four batches are here shown; on other operations single batch light trucks were used. Note as in Fig. 7 the high quality of all equipment.

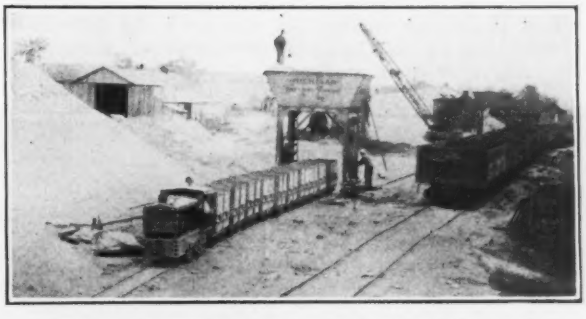


FIG. 3—STOCKPILE AND LOADING PLANT FOR TRAIN HAULAGE
Note siding for bringing in material, the unloading crane, overhead steel charging bins and industrial train carrying batch boxes.

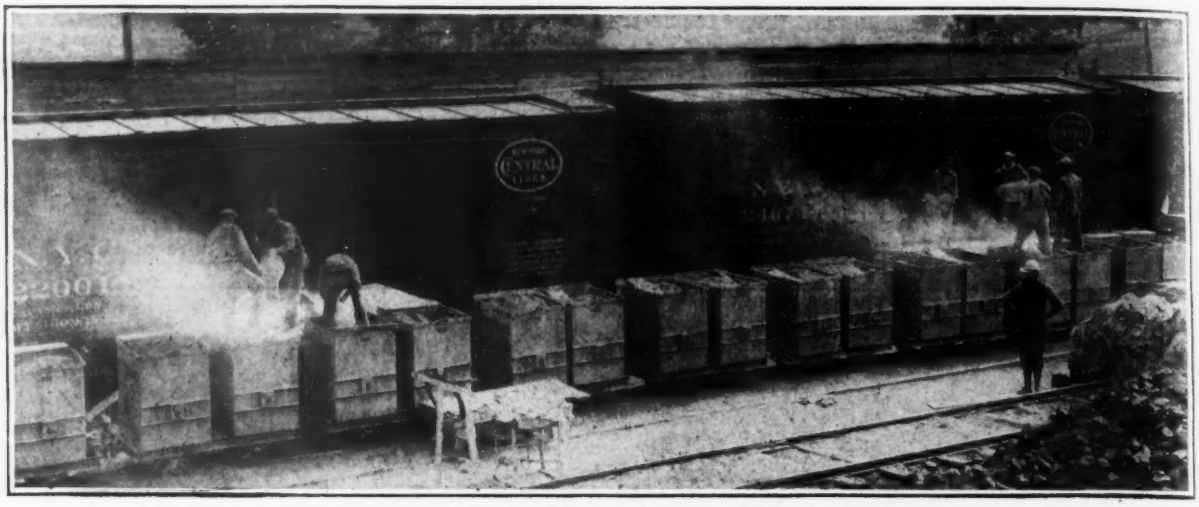


FIG. 4—CHARGING CEMENT TO BATCH BOXES ON TRAIN
Cement house is shown beyond railway cars. When cement train is not in, cement is taken from storage.

as shown by Fig. 7. The center joint is the common type. No marginal dowel bars are used, however, the thickened edges being called upon to carry the load alone. One feature that stands out is the plentiful provision of expansion joints. These are put in regardless of season. The rule is to place the equivalent of a 1-in. transverse expansion joint for every 100 ft. of length.

Outfits and procedure on state paving jobs are notable only as being new and improved, as indicated by the plant and construction views, Figs. 1 to 6. Few contracts for concrete roads are equipped so completely and expensively. The results obtained are a more significant fact.

Day-Labor Efficiency—What do the records indicate have been the efficiency, the quality and the costs of day-labor road building? These properties are interdependent in a large measure but it is a more simple method to consider them separately. Labor efficiency is a property difficult to measure in quantitative terms. Judgment and opinion as well as output records are factors in the conclusion. In Michigan the outstanding feature of day-labor road construction is the employment of convict labor generally in combination with free labor. The convicts selected are usually short-term men, are fed and lodged by the state and are paid $1 a day. A typical prison camp is shown by Fig. 8; it is merely a tent camp much like any construction camp except that it is fenced, has a single entrance, Fig. 9, where the men are checked in and out, and is under watch. Instead of elaborate guarding, dependence is placed on the selection of convicts and on the common sense of a short-term man not to hazard his right to early discharge by running away. Again the pay and the living are good and except for the gesture of confinement the prisoners are about as much at liberty as the free labor. There have been few escapes of convict laborers. Free laborers living at camp are separately housed.

Convicts generally are confined to common labor duties. Most skilled labor is employed labor. As workmen the convicts have moderate efficiency. To be kept going they require close foremanship and the foreman has to keep steadily "on top" of them. Insubordination is not particularly a trouble. Merely they are unconcerned and therefore apathetic workmen. Probably the feeling of all in direct charge of work is that they

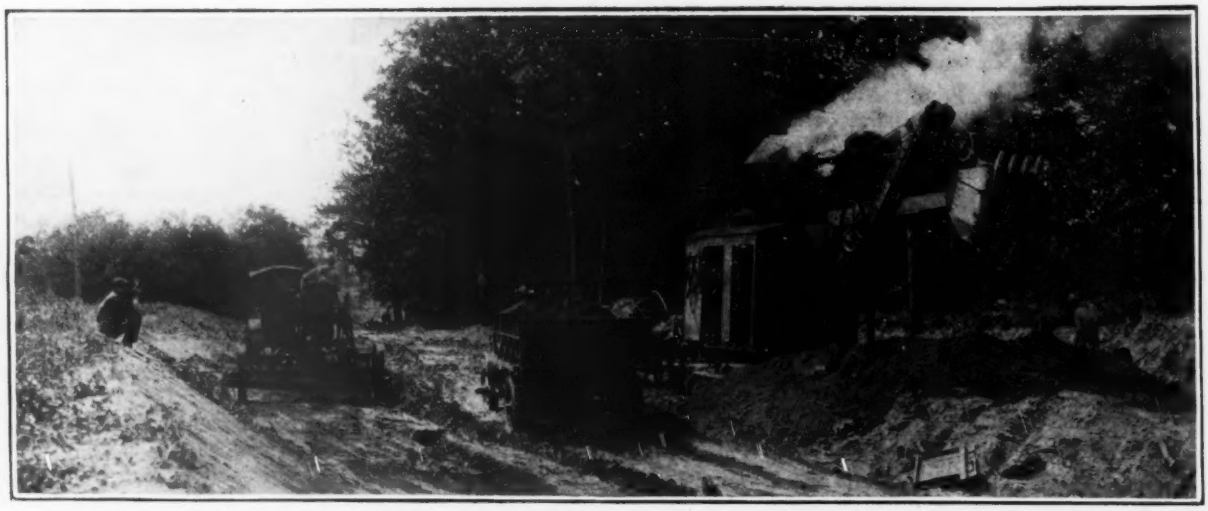


FIG. 5—GRADING OUTFIT ON RELOCATION WORK
Observe again the high character of equipment—steam shovel on crawler traction, motor trucks and tractor hauled grader.

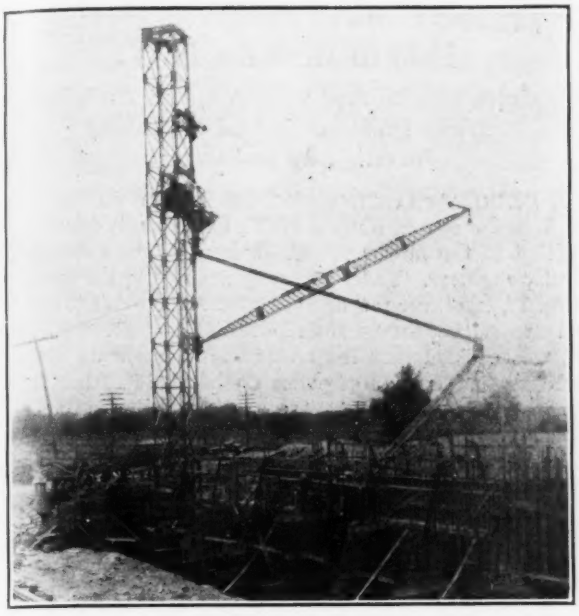


FIG. 6—STATE OUTFIT ON CONCRETE BRIDGE CONSTRUCTION
This is a highway-railway grade separation.

would prefer free labor at regular wages but that they have no violent opposition to register against convict common labor.

had been 3,600 ft. a week. The first operation employed industrial railway haul and the second employed single-batch truck haul. Both operations were well equipped with the character of plant shown by Figs. 1 to 6.

Day Labor Quality—Quality of construction is more difficult even than labor efficiency to express in quantitative terms. Considering all the day-labor paving done since 1923, the quality is not uniform. As observed, the best day-labor concrete roads in Michigan are as good as any. There are others which are no better than many. These are opinions based on observation only. Observation and inquiry are also the basis for the conclusion that it has been a condition of control or supervision whether the quality were good or less good. In the state administration of roads the highway department construction division head is not under the command of the highway department engineers. He is an independent appointee, largely free from dictation. If he elects he can do quite differently than the engineers want done. In the three-year period of Michigan day-labor road building there have been road jobs which do not average up in quality because the then head of the construction division did not do work in these instances that met the specifications and could not be made to do it. With a construction manager who worked in harmony with the engineers high quality road building had been done. Indeed, in smoothness, which is a fair index of construction quality, recent Michigan day-labor road construction is not often surpassed. In modification of this personal appraisal of day-labor road construction Mr. Dillman states:

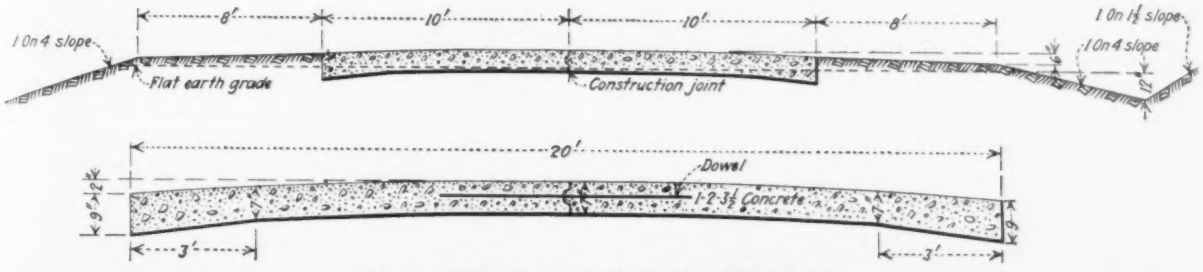


FIG. 7—STANDARD MICHIGAN CONCRETE ROAD

These conclusions arrived at by observation and confidential inquiry are not conceded by the executive officials of the road department. Their conclusion as expressed by G. C. Dillman, deputy commissioner and chief engineer, is as follows: "The foremen and superintendents in charge of state construction, and this is also true of our own highway department engineers on state construction, feel that the general run of prison labor such as we have had on these road and bridge projects is about on a par with free labor and these men have no preference for free labor over the convict labor."

In considering output it is important to note the road section, as shown by Fig. 7, being constructed. The width of pavement is 20 ft. with a slab section of 9:7:9 in., and is the equivalent of a 20-ft. slab 7.3 in. thick. From the daily records examined of seven mixers on four separate jobs the summaries and averages given in the accompanying table are computed. In checking up on two operations visited the results were as follows: On one, a standard road, Fig. 7, the average output per day worked was 550 ft. About 30 men were around the mixer. On the second operation the average was 500 ft. For three consecutive weeks the output

I would say that there were a good many arguments between the engineers and superintendents in the early stages of state construction. However, this has largely been eliminated and the work that has been done outside of the first year has been consistently good. We believe the quality of work speaks for itself and are satisfied that the quality averages up to, if not a little better than, most any contract work. The superintendent in charge of state construction for the past year has been co-operating very well with the State Highway Department engineers and I

AVERAGE DAY'S RUN OF SEVEN STATE MIXERS ON VARIOUS JOBS

These mixers poured standard 9-7-9-in. pavement, 20 ft. wide, averaging 7.3 in. in thickness

	Total Lin.Ft.	Days During Which Mixer Worked	Average Lin.Ft. per Day
Federal Aid 95 Def.			
Mixer 1	47,911.5	103	465.2
Mixer 2	32,275.3	90	358.6
Mixer 3	3,937.9	15	262.5
(Mixer 3 was in a very hilly section, with very many superelevated curves, some widened, and was fed by truck haul.)			
Federal Aid 67 A1 and A2			
Mixer 1	9,654	21	459.7
Trunk Line 23-13			
Mixer 1	18,227	42	434
Federal Aid 82B			
Mixer 1	20,382	51	400
Mixer 2	23,513	53	443.6

The number of days worked for each mixer is the total number of days during which the mixer was in operation for any period at all, whether it laid twenty feet of pavement or six hundred.

believe is equally interested with them in producing high grade work at reasonable cost.

You state that there has been road that does not average up in quality because the then head of the construction division did not do work that met the specifications and could not be made to do it. I would say that this statement is not true except for a few instances during the first year. As stated above this matter has been disposed of and what you cite should be confined to a few exceptions.

FIG. 8—CAMP FOR PRISON LABORERS ON ROAD WORK
This camp on trunk line 10 south of Flint was the first operated on state road work.

Our division engineer having charge of all construction work in the division where state construction work is under way, states that he conscientiously believes that the average efficiency on state construction work during the season just closed was somewhat above that of the average of contractors.

Here then opinion rests with no very gr at divergence. The point is illustrated, and it is a fundamental point, that without identity of mind in construction management and engineering supervision day-labor work offers hazards to quality.

Day-Labor Costs—In undertaking day-labor construction the common practice is to ask for bids on full plans and specifications. This is not always done. When it is done the low bid is taken as the budget for day-labor expenditure. The plans and specifications

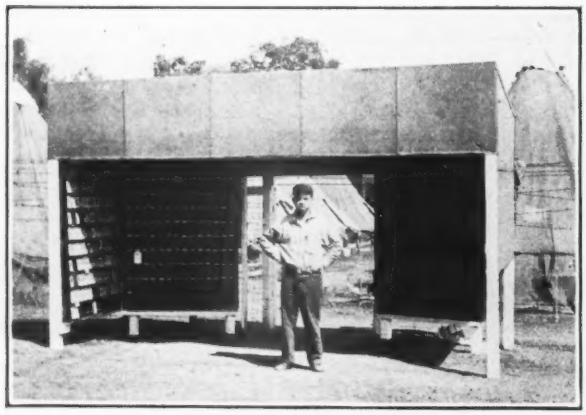


FIG. 9—ENTRANCE TO PRISON CAMP
Note the in and out record boards with photographs of the men to enable identification.

are supposed to govern exactly as if the work were under contract. Cost keeping is intended to include, besides direct construction expenditures, plant rental, overhead and every other reasonably chargeable cost. At this writing costs are not available in full for any of the day-labor operations. The opinion reached from a study of projects was that field costs ran about even with prevailing contract costs for the same items. There was no means of arriving at overhead costs.

Traffic Control Progress During 1925 in Buffalo, N. Y.

Engineer Has Worked with Police on Their Daily Traffic Problems Instead of Making Investigation and Report

A REPORT on traffic control development during 1925 in the city of Buffalo, N. Y., has recently been submitted to the mayor by W. B. Powell, the consulting traffic engineer. Under authority granted by the council, Dec. 17, 1924, the mayor appointed Mr. Powell to make an engineering survey and report on the traffic situation. It was decided that the traffic engineer should act as advisor to the chief of police during 1925 rather than to make a report of recommendations following an intensive survey. Such a policy was adopted because it was felt that the very size of such a report would defeat its purpose and because the immediate consummation of its recommendations would probably cost far more than the amount of budget funds available. "The success which has accrued to this method of making the survey is clear proof of the wisdom of its adoption."

There was submitted during the year a series of seventy written recommendations, all of which concerned only those things which may be put into operation within a reasonable time. In the report to the mayor there were presented only major items of a more general character upon which adequate details could be formulated. The major items considered and some of the recommendations made are enumerated below.

Accidents—During preceding years, no summarized records of accidents or fatalities were kept at police headquarters. During the year the following plans were adopted at police headquarters to remedy this condition: (1) Every accident is reported to the state motor vehicle bureau; (2) a monthly tabulated summary of all accidents is made up in which the character of the accidents is very fully analyzed; (3) the locations of all accidents in the city are posted daily on a large spot map from which the points of greatest hazard can be determined; (4) the locations of motor fatalities are also posted daily on a smaller spot map; (5) for comparison with these accident and fatality maps, a large spot map showing the location of all traffic control signals is used; (6) a permanent card index record is kept of all the motor drivers arrested for any traffic violations.

Traffic Ordinances—It is recommended that the entire body of traffic ordinances be revised so that a clear definition of the powers of the police for the regulation of traffic may be before the courts.

Traffic Court—The establishment of a traffic court is strongly advocated since the mere difference in personality of city court judges inevitably produces a certain amount of variation in judgment upon cases that are practically identical. It is felt that such a court would have a salutary effect on traffic conditions.

Police Department Organization—The administration of traffic regulation should be placed under the command of one man reporting directly to the chief of police. Planning traffic regulations is now recognized as distinctly an engineering problem and there should be added to the force a consulting engineer whose duty it shall be to approve all plans for changes in traffic control, but who shall have no authority of administra-

tion. A traffic school should be established for all men of the department.

Speed Regulation—It is recommended that arbitrary limits of speed be abandoned and that instead the regulation of speed be based on the simple law proposed by the National Bureau of Standards as follows: "No vehicle shall be operated at a speed such that it cannot be stopped within the assured clear course ahead." It is felt that this rule can be enforced with a minimum of police effort and is in fact the one followed by all safe, experienced drivers.

Arterial Traffic Streets—It is necessary to warn all approaching vehicles on every intersecting street that they are required to stop before entering or crossing an arterial street. At all points where arterial streets intersect, the traffic movement at the corner should be controlled by automatic "stop and go" signals, timed in proportion to the average flow of traffic on each street and so arranged that the timing can be changed to meet peak loads at the rush hours.

Automatic Control Signals—At present Buffalo has 42 street intersections under the control of 71 signals which offer no uniformity as to either style or location. These should all be standardized in accordance with the following general specifications: (1) Show only two colors arranged vertically with the red "Stop" always at the top and the green "Go" underneath. (2) Time the red "Stop" signals so that they will show in both directions during the change for a period of time sufficient to clear the intersection entirely. To safeguard the pedestrian completely, the present rule permitting a right turn against the signal should be rescinded. (3) Locate signals in the same standard positions at all corners, preferably (a) one on each corner showing in a single direction or (b) two on diagonally opposite corners showing in all four directions. (4) Locate no signals in the pavement area of a street intersection except in a few special locations where the space is so great that bracketed corner signals are too far away for effective control of the crossing. (5) Make lenses at least 8 in. in diameter and adjust the beam of light to intercept the principal lane of traffic at a point about 150 ft. from the corner. (6) Use blinker signals only for danger warnings at dead-end streets and similar points of hazard. Use red in the danger direction and orange in the other direction for caution. The promiscuous use of red in all directions is misleading and dangerous.

Signal Control in Business Center—Automatic signals in the business center should be so synchronized into one unit system that a vehicle moving in either direction at an average reasonable speed should be able to proceed with little or no interruption through the entire controlled area.

Segregation of Traffic—Various classes of traffic should be segregated in the business center as far as possible so that each class may proceed at its own best speed without interruption from other classes. Route through traffic around the business center on selected routes which are plainly marked with signs.

Rerouting of Street Cars—Traffic will be considerably expedited if street cars are routed on the downtown loops in a single direction instead of both ways on the same street.

Parking—The locations and time limits for parking should be exclusively within the jurisdiction of the police department with full power to modify them from time to time to meet changing conditions. Standardized signs should be installed wherever any restrictions are in force and the law should clearly distinguish between parking and loading zones.

Signs—All signs should conform to the recommendations of the Bureau of Standards. They should always be installed in the same relative location. One-way street arrows should be larger and used much more freely.

Snow Removal—It is recommended that the snow removal ordinance be so revised that the property owner be required to pile the sidewalk snow on the edge next to the curb, but that he be forbidden to put any of it in the roadway. Furthermore, on those streets where it is impossible to remove all the snow from the street promptly, it should be provided that the snow from the vehicle roadway may be legally piled on the edge of the sidewalk next to the curb. On most city streets the proportion of width devoted to sidewalks is in excess of pedestrian demand, while the roadway width is considerably less than the vehicle traffic requirements. The street cleaning department should co-operate closely with the street railway company, so that every railway plow shall be immediately followed by a city motor truck plow that will push the snow clear to the curb line instead of leaving a ridge of snow near the tracks, thus forcing all motor traffic onto the car tracks and resulting in serious delays to both classes of traffic.

Public Education—A definite result of the campaign for safety education in the schools was a 50 per cent reduction in fatalities to children in 1925 over 1924. However, adult fatalities increased, indicating the need for adult education on public safety similar to the campaign conducted for the children. Such a campaign of education should be conducted through the newspapers and by means of public meetings. A publicity director should be employed to see that fresh material is supplied each week in picture form as well as in reading notices.

Miscellaneous—A few of the 70 recommendations that have a general application follow: (1) Time lights to eliminate yellow between red and green; (2) Change perpendicular into diagonal parking; (3) Remove mushrooms in center of street intersections; (4) Traffic officers should time their signals with adjoining automatic control signals; (5) Diagonal parking should be at 30 deg. instead of 45 deg; (6) Traffic signal positions should be selected by traffic counts; (7) The inside of the signal light hood should be painted black; (8) Prevent double-line parking; (9) Adopt as a standard two-deck control signals with overlapped reds.

A great majority of the recommendations made have been carried to completion while most of the others are in various stages of execution.

Old Line of Cement-Lined Wrought-Iron Pipe

After more than a half century of use a line of 24-in. wrought-iron pipe lined with 2 in. of cement mortar, now forming a part of the Boston Metropolitan Water System, appears on cutting into it to be in good condition, with only a little slime on its inside. The pipe was laid in 1871 as a part of the old water-works of Charleston, Mass., subsequently included in Boston. W. E. Foss is chief engineer and J. L. Howard is deputy chief engineer of the Water Division of the Metropolitan District Commission.

River Control at the New St. Louis Water-Works

Expensive Works Essential to Hold River Channel to Course in Front of Plant—Brush Mattresses and Pile Dikes Effect Predicted Changes and Add 300 Acres of New Land

By Edward E. Wall
Formerly Water Commissioner, and Recently Director of Public Utilities, St. Louis, Mo.

IN LOCATING a site for the additional water-works for St. Louis, it was realized that no matter what place on either the Mississippi or Missouri River was chosen, it would be necessary to direct and control the channel and protect both banks of the river.

Knowing the character of the river, it was decided to divert and so control the river that the main channel would be against the south shore, assuring continuous deep water there for the intake. In other words, instead of running the intake pipe to deep water the deep water was brought to the shore.

Since the building of the existing water-works of St. Louis in 1888-92 at the Chain of Rocks, more than $500,000 has been spent for bank revetment and dikes to keep the main channel of the Mississippi River from leaving the intake towers high and dry in low water. When it was finally decided to locate the new works on the Missouri River at Howard Bend, about eight miles above St. Charles, Mo., it was with a full knowledge of the fact that the river control work would be expensive and hazardous to construct, difficult to maintain and, to put it mildly, somewhat doubtful as to its successful issue. A portion of the work has been completed and the results so far have been as expected.

Because of the tremendous quantity of suspended matter carried in the river water, sand bars are formed with amazing rapidity during the higher stages. The smallest obstruction, such as a water-soaked log or a fallen tree caught in a shallow place, is sufficient to start a bar which may in time become a wooded island dividing the channel, or possibly join itself to the mainland and divert the channel against the opposite bank. Throughout the ages the Missouri River has meandered at will along and across the alluvial bottoms, overflowing the lowlands, cutting away rich agricultural lands at one place and forming accretions not far away, so that in all probability the main channel at some time has occupied every foot of area between the bluffs.

At Howard Bend the river is about 8,000 ft. wide from bank to bank, forming, in moderately high water, a magnificent stretch of water, turbulent, swiftly flowing, eddying around and about obstructions and boiling up sand and silt in its tortuous course between its banks and the islands, which are overflowed only at extreme high water. To say that the water is muddy imperfectly expresses its condition. To those accustomed to the clear waters of the eastern and western rivers, the turbidity of the Missouri river is unthinkable. At its best during the lowest stages in the winter it probably carries more suspended matter than the average eastern stream at any time except during flood stages. It has been estimated by government engineers that every year the Missouri carries into the Mississippi enough sediment to cover a square mile 400 ft. deep. In 1923 a maximum turbidity of 16,000 p.p.m. was reported by water-works officials at Kansas City, Mo.

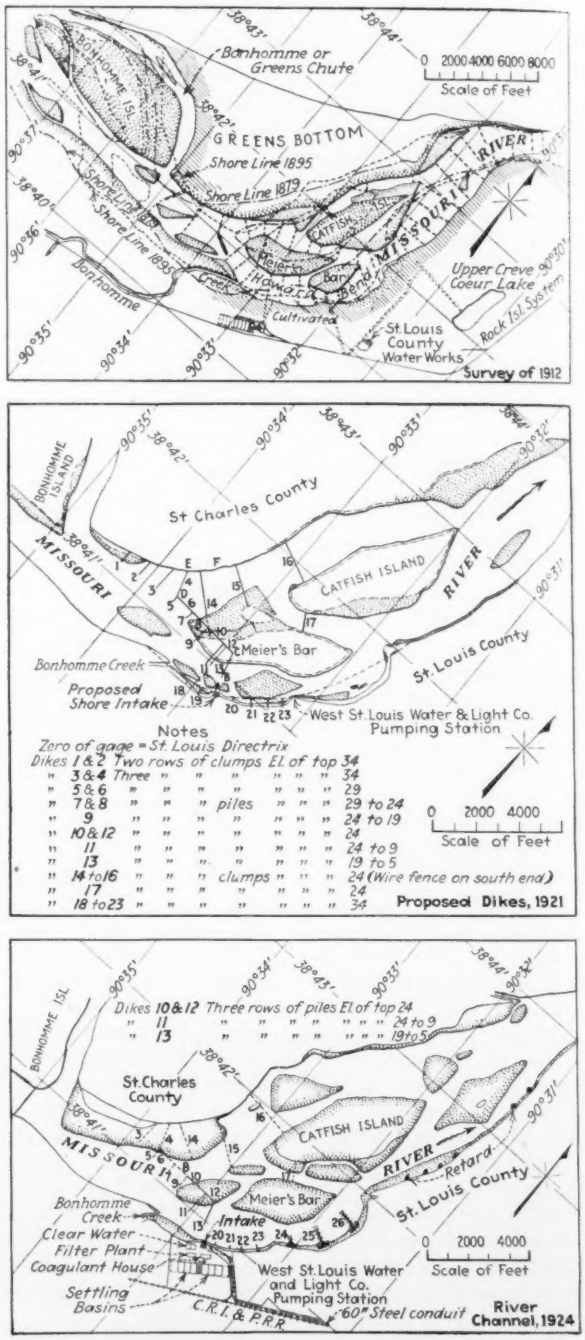
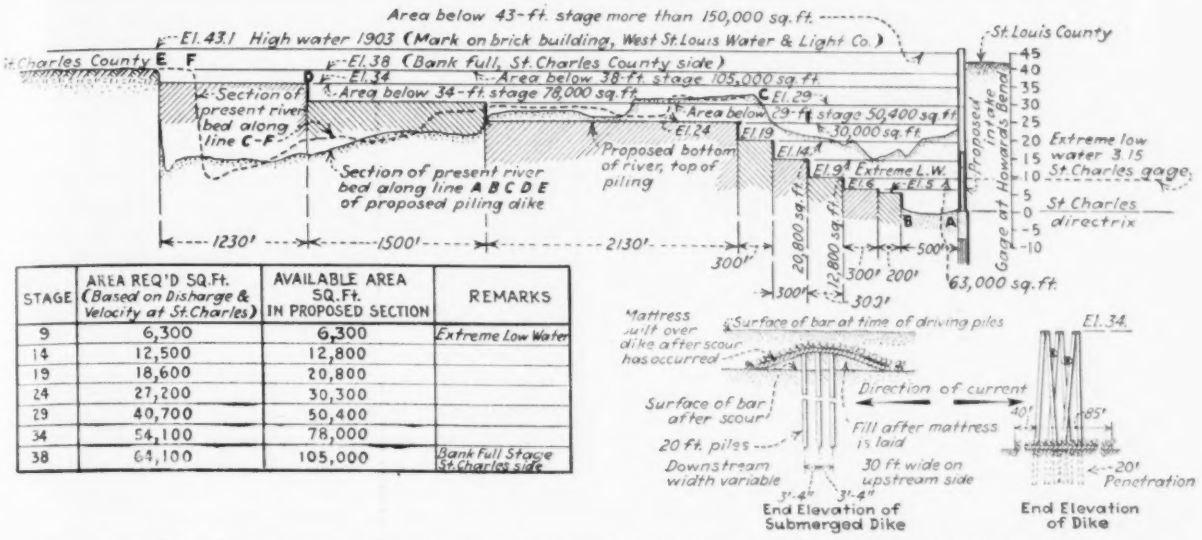

Bonhomme or Greens Chute
Scale of Feet
GREENS BOTTOM
Shore Line 1895
Shore Line 1879
Shore Line 1815
Shore Line 1895
CATFISH
MISSOURI
RIVER
Meier's Bar
Howard Bend
Bonhomme Creek
Cultivated
Upper Creve Coeur Lake
St. Louis County Water Works
Rock 1st System
Survey of 1912
BONHOMME ISLAND
St Charles County
CATFISH ISLAND
St. Louis County
Proposed Shore Intake
West St. Louis Water & Light Co. Pumping Station
Notes
Zero of gage = St. Louis Directrix
Dikes 1&2 Two rows of clumps El. of top 34
" 3&4 Three " " " " " " 34
" 5&6 " " " " " " " 29
" 7&8 " " " piles " " " 29 to 24
" 9 " " " " " " 24 to 19
" 10&12 " " " " " " 24
" 11 " " " " " " 24 to 9
" 13 " " " " " " 19 to 5
" 14 to 16 " " " clumps " " " 24 (Wire fence on south end)
" 17 " " " " " " 24
" 18 to 23 " " " " " " 34
Proposed Dikes, 1921
Dikes 10&12 Three rows of piles El of top 24
" 11 " " " " " " 24 to 9
" 13 " " " " " " 19 to 5
St. Charles County
CATFISH ISLAND
MISSOURI
RIVER
Retard
St. Louis County
Meier's Bar
Intake
Bonhomme Creek
Clear Water Filter Plant
Coagulant House
Settling Basins
West St. Louis Water and Light Co. Pumping Station
C.R.I. & P.R.R.
60" Steel conduit
River Channel, 1924

FIG. 1—CHARACTER OF RIVER AT INTAKE SHOWING PROPOSED CONTROL WORK

The survey of 1921 compared with that of 1912 shows the South channel almost blocked, whereas in 1912 there were two principal channels, one north and the other south of Meier's Bar. The dikes were put in to re-establish this condition.



STAGE	AREA REQ'D SQ.Ft. (Based on Discharge & Velocity at St. Charles)	AVAILABLE AREA SQ.Ft. IN PROPOSED SECTION	REMARKS
9	6,300	6,300	Extreme Low Water
14	12,500	12,800	
19	18,600	20,800	
24	27,200	30,300	
29	40,700	50,400	
34	54,100	78,000	
38	64,100	105,000	Bank Full Stage St. Charles side

FIG. 2—SECTION OF RIVERBED BEFORE BUILDING DIKES; AND DIKES WITH CLUMPED PILES AND MATTRESSES

Samples taken at Howard Bend that year and tested at the laboratory of the St. Louis water-works showed a maximum turbidity of 12,000 p.p.m. or about 50 tons of sand and silt in every million gallons of water.

As shown in Fig. 1 the survey made by the St. Louis Water Department in 1912 reveals the fact that the water in Howard Bend flowed in two principal channels, one along the south bank and the other between Meier's Bar and Catfish Island, very little water flowing north of Catfish Island. At that time with the river at a medium stage, the water was about 30 ft. deep just opposite and about 50 ft. out from the point on shore where the water-works intake was to be located.

In 1921, another survey by the St. Louis Water Division was made (Fig. 1). Here the main channel is along the north bank, the head of Meier's bar has been cut away, another bar formed above Catfish Island and the small bars above Meier's Bar in 1912 have been merged into one bar of considerable size almost completely blocking the south channel and forcing the channel to the north. The system of 23 dikes proposed for forcing the channel back to the south bank and keeping it there during medium and low stages of water is shown. Fig. 2 shows a cross-section of the river bed before work was started. The dikes are designed of such heights as to allow sufficient waterway during high water. The dikes in profile and the comparative waterways for the river before and after the dikes are built are also seen in Figs. 1 and 2.

This proposed method of river control was submitted to the engineers of the U. S. War Department and approved by them, the only reservation being that dikes 11 and 13 be not extended as far southward as shown on Fig. 1 until the effect of the rest of the system had been observed. This fitted in well with the plans of the Water Division, as it was not the intention to build these two dikes unless it became necessary to narrow the low-water channel so that deep water could be had at the intake at mean low water. Dikes 14, 15, 16 and 17 were designed not only to shut off the flow of water through the channel north of Catfish Island and that between Meier's Bar and Catfish Island, but also to prevent any opening of those channels by future high water, which might break through a single dike but hardly through three or more after they were well sanded in.

Dike Construction—The method of constructing these dikes is shown on Fig. 4. At the shore end of the dike the bank is graded to a slope of 3 to 1 for a distance of 100 ft. above and 200 ft. below the dike.

FIG. 3—TYPICAL MISSOURI RIVER MATTRESS

FIG. 4—PILE DIKE UNDER CONSTRUCTION

This bank below low water is covered by a woven-willow mattress 125 ft. wide, sunk and weighted with stone. About 4 cu.yd. of stone per 100 sq.ft. is distributed as evenly as possible over this shore mattress.

The bank above low water is covered with crushed stone, 3 in. and smaller, to a depth of 3 to 6 in. Over this layer is then placed heavier stone, ranging in weight from 20 to 160 lb. The total thickness of bank paving is from 15 to 18 in. The purpose of the shore mattress is to prevent undermining the bank, and opening the way for a channel behind the dike, while the bank paving protects the sloping bank from cutting away at the higher stages of water.

Overlapping the shore mattress about 20 ft., and with the center line approximately 117 ft. below the up-

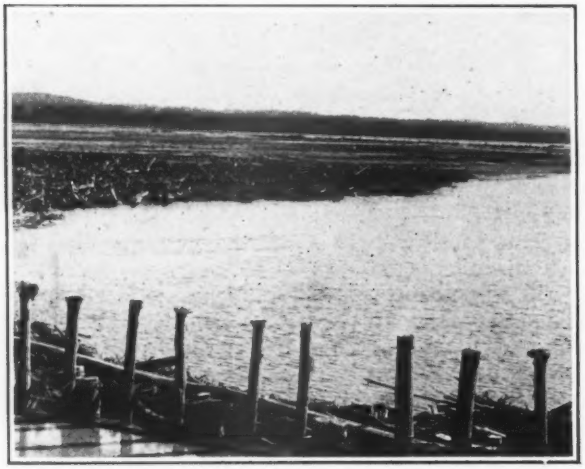


FIG. 5—BARS FORMED THROUGH DIKE CONSTRUCTION

stream edge of the shore mattress and extending into the river at least 60 ft. beyond the end of the dike, is woven a channel mattress 125 ft. wide, the piles forming the dike being driven approximately along a line 45 ft. below the upstream edge of the channel mattress. As the mattress is woven, it is sunk in place and weighted down with stone, about 2 cu.yd. of stone being distributed over each 100 sq.ft. of mattress, a somewhat heavier layer of stone being put on the shore end where it overlaps the shore mattress.

The mattress is what is known as the brush mattress, Missouri River type, and is made of young willows, cut off the lowlands along the river, the islands and sand bars, where they grow in great profusion. The willows suitable for this type of mattress are from ¾ to 2 in. in diameter at the butts and from 15 to 25 ft. in length.

The mattress is started by binding a roll of willows 15 in. in diameter with four turns of galvanized wire every 3 ft. Butts of willows are thrust through this roll and woven under and over in strands of from four to seven willows in basket fashion, making a tightly woven surface, with all the top ends underneath. The mattress is strengthened and held together by a system of ⅜-in. galvanized iron cables spaced about 20 ft. apart longitudinally and 16 ft. transversely, both on top and underneath the mattress. At all intersections the four cables are drawn together through the mattress and fastened by U-bolts. Fig. 3 shows a mattress in course of construction.

The dikes proper consist of six rows of piles driven and clumped according to the plan shown on Fig. 2, forming when finished what is known as 3-row hurdle dikes. All piles are driven butts down with about 20-ft. penetration. The appearance of a dike just after the piles have been clumped is shown in Fig. 4.

How Dikes Work—As long as the water flows through one of these dikes, no matter what the stage of the river, its velocity is reduced and sand and silt are deposited both above and below the dike. As the river rises floating driftwood lodges against the dike, retarding the flow of water more and more, until the sand and silt deposit is almost as high as the dike, and all flow through is stopped. As the passage of water through the dike becomes more and more obstructed, a considerable difference in the elevation of the water above and below the dike takes place. This produces a swift current around the outer end, which tends to swing at a sharp angle in its attempt to flow into the lower level below the dike. This produces an area of dead water in which currents and cross currents flow so slowly that all the heavier sediment settles out rapidly and a sand bar soon appears below the dike.

A contract for building fifteen of these dikes was let on June 12, 1923, to the Kansas City Bridge Co., the Water Division reserving the right to build all or part of them as conditions required. By May 23, 1924, when the river began to rise, the contractor had built dikes, 3, 4, 5, 14 and part of 15. Fig. 5 shows the effect of these dikes in forming bars. Later in the summer, after dikes 15 and 17 were partly built, a bar formed from opposite the end of dike 5 to the head of Catfish Island, dividing the channel and bringing a large volume of water down the south bank, where there had been practically no current before the dikes were built. Along the north shore, where in the fall of 1922 there was a channel depth ranging from 8 to 19 ft., there are now sand bars above water.

During the past year dikes 6, 7, 8, 9, 16, 20, 21, 22 and 23 were built. Fig. 1 shows the changes over the 1921 condition in the channel, the sand bars and islands as revealed by a survey made late in 1924. More than 300 acres of land have already been added to the north shore, and it is evident that a much larger area will be filled during the next high water. The diverted current began to cut away the south bank just below the pumping station of the West St. Louis Water & Light Co., necessitating the building of three short dikes, which are under construction.

The total money spent on the dikes and bank protection up to about the close of 1925 was $644,900. The cost of the three now under construction is estimated at $80,000.

The effects produced by the dikes so far built serve to confirm the belief that when the system is completed the main channel will flow against the south bank at all times, and during low water all of the water in the river will be confined to a comparatively narrow waterway in front of the water-works intake. It is realized that it will require perpetual maintenance of the control works to keep the river in place, and that in all probability additions may have to be made to prevent cutting at points removed a considerable distance from the water-works; but, as stated before, this would have to be done at any location for water-works on either of the two great rivers.

Tunnel Driving and Shaft Sinking in Slaking Rock

Tunneling for New Kansas City Water-Works Made Difficult by Sloughing Rock and Water-Bearing Gravel—Four Identical Construction Plants Used

GRAVEL laden with water and rock which slakes like quicklime in the air complicate the extensive tunneling under way for the water supply of Kansas City, Mo. Another complexity has been a dearth of men trained in tunneling. Miners have been about the only skilled workers available and they have been hard to wean away from practices not suited to tunneling. The tunnels too are of small section and the longer, almost three miles, has been driven wholly from the portals. Again, the bore because of slaking rock has to be lined almost as fast as it is advanced. These conditions greatly hinder fast mucking and hauling.

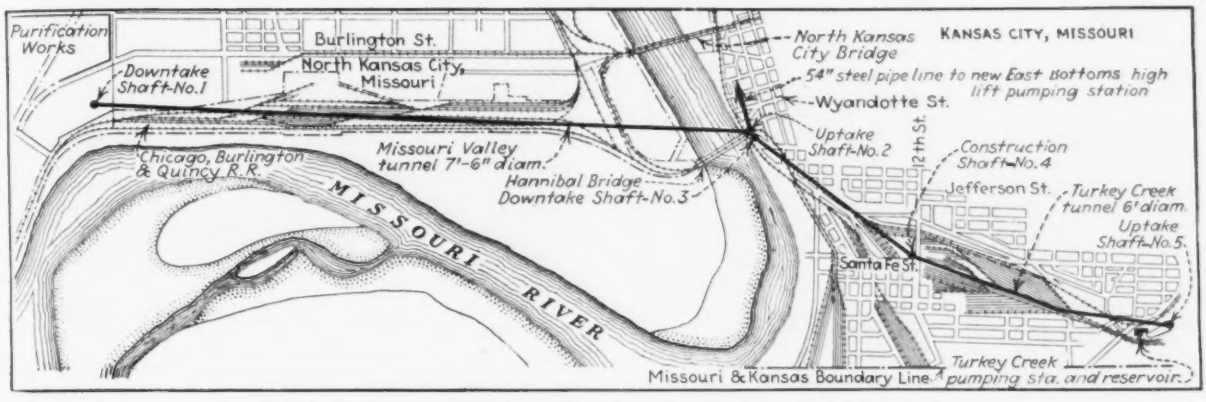


FIG. 1—MAP OF TUNNEL LINES, NEW KANSAS CITY WATER-WORKS

Altogether the difficulties have been rather outstanding and merit narration. They have been met by intelligent methods but by none of striking novelty.

Tunnel Structures—Two pressure tunnels and a steel pipe line will carry the filtered and chlorinated water from the new purification plant of the Kansas City, Mo., water-works to the high-pressure distributing stations. One of these, the East Bottoms station, is now under construction and the other, the Turkey Creek station, has been in use for some years. The tunnel routes are shown by Fig. 1. The main or Missouri Valley tunnel is a 7½-ft. diameter concrete-lined tunnel 15,500 ft. long bringing the water from the purification works in North Kansas City across the Missouri Valley and under the Missouri River to an uptake shaft on the south bank. Here the water rises to the top where 30 per cent of it is diverted into a 54-in. riveted steel pipe line operating on a hydraulic gradient and connecting with the new East Bottoms pumping station. The remaining 70 per cent of the water is carried to a downtake shaft, 50 ft. west of the uptake shaft of the Missouri Valley tunnel, connecting with the 6-ft. diameter concrete-lined pressure tunnel 11,000 ft. long discharging by an uptake shaft into the Turkey Creek reservoir. There is a construction shaft about mid-length of this tunnel.

Plant Layout—Four practically identical plants are operated at the five different shafts, all by electricity. There is a plant at each end of the Missouri Valley tunnel; one at the uptake end of the Turkey Creek tunnel and one at the middle shaft of the latter. The plant at the uptake end of the Missouri Valley tunnel serves also the downtake shaft of the Turkey Creek tunnel. Current at 13,000 volts is stepped down to 220 volts. Electric hoists operate the cages. Motor-driven air compressor sets and direct-connected blower outfits form parts of the plant equipment. The blower serving shafts 2 and 3, Fig. 1, is capable of delivering 4,500 cu.ft. of free air per minute. Materials are brought to shafts 2 and 3 by rail while motor trucks serve the other plants. Elevating bucket loaders place the sand and stone in the bins above the concrete mixers. The mucked material at shaft 2 is brought up in the cage to an elevated platform. The muck cars run out over bins and are emptied, the shale being chuted to railway cars; its final disposition is for railroad fill.

Shaft Construction—The methods used in sinking the different shafts varied of course with subsurface conditions. Open shaft blasting and excavating, open caissons and finally pneumatic caissons were all found necessary on different parts of the work.

On the Missouri Valley tunnel, shaft 2 (Fig. 2) was the first completed. It was sunk 280 ft. through shale, sandstone and limestone with a majority of the rock shale. This material after being exposed to the air for only a short time disintegrated very badly; it was therefore necessary to place the concrete lining rather closely behind shaft excavation. The contractor required all of his men working in the shafts to wear steel helmets such as the American soldiers wore in France. Excavating was accomplished by the open method since the rock came practically to the ground surface. About 3½ ft. of the 10-ft. diameter shaft was shot and mucked per eight-hour shift. Eighteen holes were drilled for the pull shot and 24 additional holes were used around the edge. All drills are of the rose bit type, decreasing ⅛ in. in diameter for each 2 ft. of length.

It was possible to sink the shafts in shale for from 30 to 50 ft. before the sloughing of the shale made concreting necessary. The shaft was shot 6 to 8 in. inside of the final line with the idea that the sloughing would

bring the shaft to section. This did not prove so very successful as the shale broke very unevenly. A method that has proved successful however is the use of heavy pneumatic pavement breakers for trimming to section. The pavement breakers have also been used in the tunnels.

A concrete pneumatic caisson was used to sink the

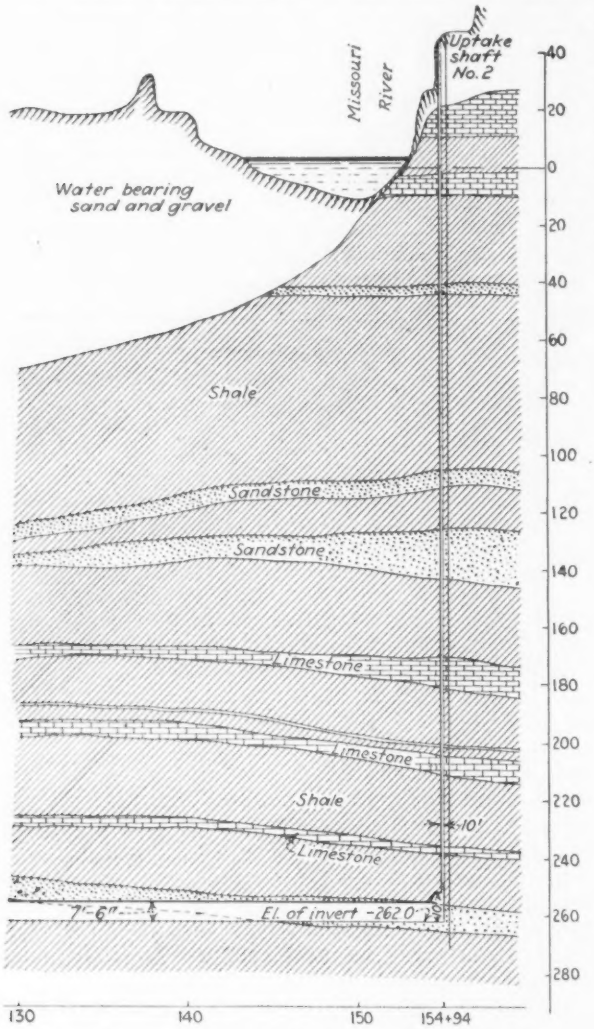


FIG. 2—GEOLOGICAL SECTION AT SHAFT NO. 2

first 107 ft. of shaft 1, Fig. 3, after about 12 ft. of top-soil had been removed. The material penetrated was water-bearing sand and gravel resting on a shale ledge into which the caisson was sealed. The caisson was constructed in a head house built over the shaft, Fig. 4. After excavating the top-soil, the cutting edge and air chamber were placed and the forms for the caisson erected on top extending to a height of about 95 ft. above the surface of the ground. The caisson was loaded with 100 tons of steel rails and sand. Some trouble was experienced in keeping this shaft in line, the caisson not sinking evenly. Air at 50-lb. pressure was used at times. After sealing the caisson into the shale the shaft was sunk to elevation —262 by blasting and mucking.

Shaft 4 was sunk merely for construction purposes to enable two additional headings to be worked in the Turkey Creek tunnel. Shaft 5, Fig. 5, just outside of the Turkey Creek reservoir, as first located, failed to hit rock that test borings had seemingly located. The water-bearing sand and gravel were not considered sufficient cover for the tunnel and the shaft was relocated. The sudden dip of the ledge surface is shown in Fig. 5.

The third method of shaft excavation, by open caisson, was used in sinking shaft 5 in its relocated position. As will be noted from Fig. 5, the rock is overlain with about 45 ft. of water-bearing sand and gravel. A pit was first dug 16 ft. deep. The caisson shoe was next set, the forms erected and a circular caisson poured 30 ft. in height. Three or four men were used to muck out by hand. Plumb bobs were used on the four quarters of the circumference to keep alignment. No air was used. The shaft was excavated 3 or 4 in. outside of the cutting edge near the bottom, the caisson practically sealing itself into the shale. However, a few

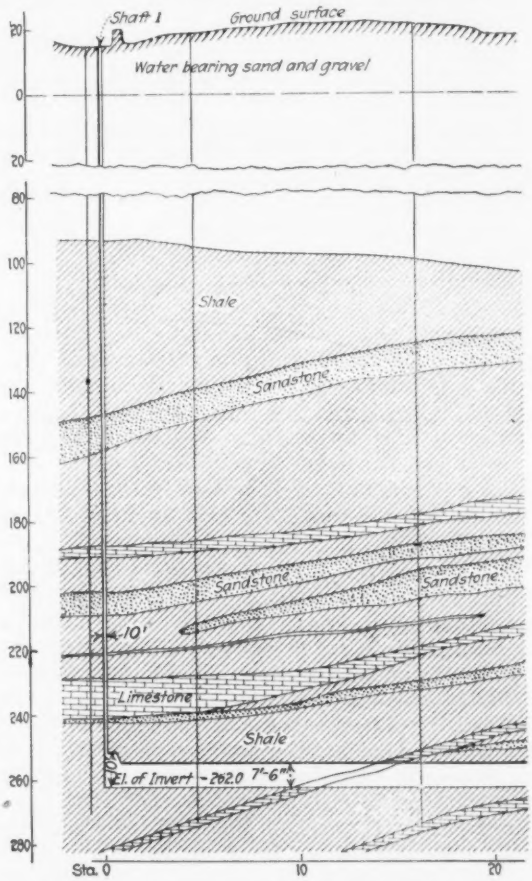


FIG. 3—GEOLOGICAL SECTION AT SHAFT NO. 1

cement sacks were used and grouting was accomplished by pipes placed in the sides when the caisson was built. The shaft was carried down the remaining distance through shale and finally lined.

Tunnel Construction—In both tunnels an enlarged section of the same bore as the adjacent shaft and 50 ft. long has been used. The engineers included this feature in the plans as an aid to the contractor in his operations. Fig. 6 shows the use of this enlarged section for the location of a siding on the industrial railway in the Turkey Creek tunnel. The transition to tunnel section is made in 10 ft. in the small tunnel and 12 ft. in the larger one.

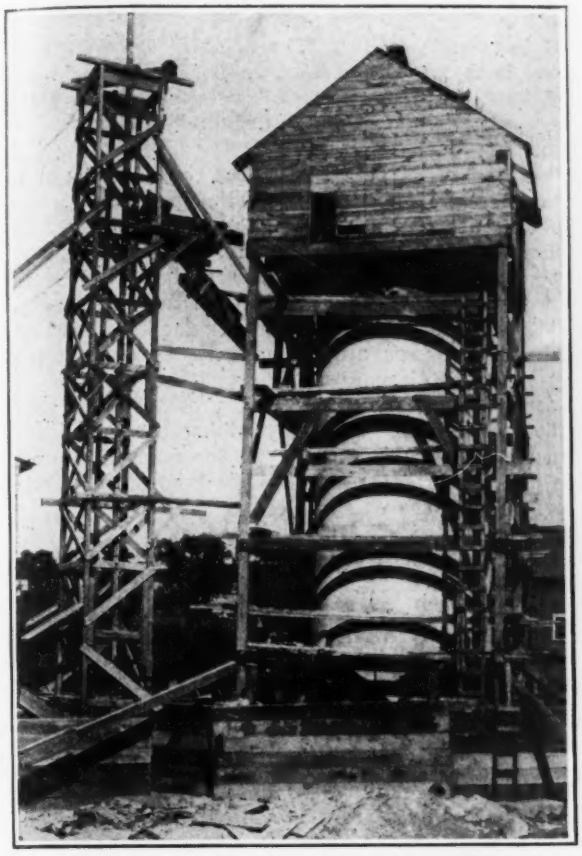


FIG. 4—CONCRETE PNEUMATIC CAISSON FOR SHAFT NO. 1

The Missouri Valley tunnel is being driven toward the center from the two end shafts. The 700 ft. of this tunnel completed as of Feb. 1, 1926, from the south end has been in sandstone and has not had to be immediately lined. Practically all remaining tunnel is in shale, however, and concreting will have to follow excavation

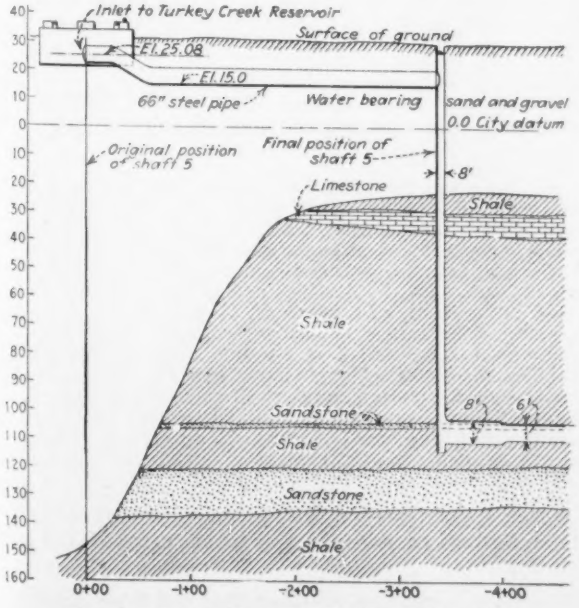


FIG. 5—GEOLOGICAL SECTIONS AT OLD AND NEW SHAFT 5 LOCATIONS

rather closely. Water, oil and a considerable amount of gas have been encountered. Three explosions have occurred. Fortunately the only serious one happened when no one was in the tunnel; the force of the concussion drove the cage into the head frame damaging

FIG. 6—TRANSITION SECTION AT FOOT OF SHAFT

it considerably. The presence of gas has been the controlling reason for lining the tunnels where shale is not encountered. Except to keep up a good circulation of air and to be careful of lights and of fire of any sort no other precautions have so far been taken.

In both tunnels drilling is a minor procedure so far as time is concerned. Holes 5 ft. deep are drilled in less than an hour and the 10-ft. holes in about 1¾ hours. Progress then is controlled by the efficiency of the transportation system. Fig. 7 shows rough firing diagrams for both tunnels. Powder of 40 per cent gelatin is being used. In the Missouri Valley tunnel an average advance of 8 or 9 ft. is being made in each 8-hour shift. This consists of two 4-ft. shots drilled about 5 ft. A pneumatic mucker was used for a time but the two short shots every 8 hours made too many moves of the mucker necessary. Some mechanical trouble was also experienced. Hand mucking is being used now but it is planned to return to the pneumatic mucker as soon

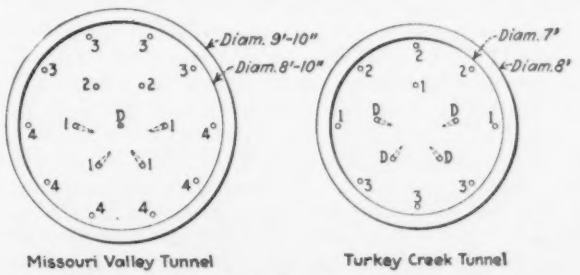


FIG. 7—DRILL HOLE DIAGRAM FOR TUNNELS

as electric locomotives are obtained for hauling the muck and concrete trains.

In drilling a 4-ft. shot, drills 2 and 4 ft. long are used for the side holes and 3, 4, and 6-ft. drills for the cut holes. In order to speed up the work, drills up to 8 ft. long for the side and 10 ft. long for the cut holes were tried. Only a 7-ft. fall could be obtained and mucked in 8 hours with this method so the two

4-ft. shots proved the faster. Furthermore most of the labor is composed of deep shaft coal mine men who are not used to extra-exact drilling methods. They would not use standards and drill posts but preferred to "man-handle" the drills. The 10-ft. steel proved too long for this method of drilling and consequently the bore became uneven making it difficult to get the powder into the crooked holes. The shale and sandstone shoot in walnut-sized pieces so that mucking is quite easy.

No concreting has been done in this tunnel as yet. The plan is to place the lining pneumatically.

The 6-ft. diameter Turkey Creek tunnel is somewhat nearer completion than the larger tunnel. It is about 140 ft. below the ground surface in shale for practically its entire length and is being driven from three shafts, one at each end and a construction shaft in the center. Construction procedure will be described working south from shaft 3. Sloughing of the shale has been serious in this tunnel and concreting must follow the excavation very closely. The contractor has experimented a great deal with the quantity of free air necessary to keep condensation on the walls at a minimum. The main requisite seems to be to keep the air circulating. The 8-ft. diameter section was driven and lined first. The tunnel was shot several inches inside of the first bore and pavement breakers were used to trim to section. The firing diagram for this tunnel is shown in Fig. 7. Two 4-ft. shots have been considered the work for an 8-hour shift. Mules have been used to transport the cars of muck.

Concrete is placed in buggy-type end dump railway cars on the surface, dropped to the tunnel in the cage elevator and hauled to the concreting point by a mule. The cars are dumped on the floor and the concrete is shoveled into the forms by hand. The forms consist of eight segments including the key plate which is at the top. Each segment is 5 ft. long. Structural angles bent to a circle form the framework for the plate segments. The forms are not movable in units, since they must be dismantled after pouring each 100-ft. section. Grout and vent pipes are provided in the roof at 50-ft. intervals. The only piping carried in the tunnel is for the blower air. At the concreting point this air is carried in a collapsible hose so as not to interfere with the wall and ceiling forms.

Smith Bros., Inc., Dallas, Texas, with Charles S. Foreman as general superintendent, has the contract for driving the tunnels and shafts. Fuller and Maitland, Kansas City, Mo., are the engineers for the new Kansas City water-works system.

Army Engineers Recommend Restricting Chicago Diversion

Report That Navigation Requirements of Illinois Canal and Chicago Sewage Disposal Needs Can Both Be Cared For With Flow of 4,167 Sec.-Ft. In Chicago River Out of Lake Michigan

ANOTHER chapter to the numerous investigations into the diversion through the Chicago River of the waters of Lake Michigan was made last week when Major General Harry Taylor, Chief of Engineers, U. S. Army, submitted to the Committee on Rivers and Harbors of the House of Representatives the report of the Board of Engineers for Rivers and Harbors on the Illinois River. The report is in response to a resolution of the committee asking a review of a number of official documents on the Chicago diversion and the answer to several questions concerning the navigation needs of the canal connecting Lake Michigan with the Mississippi, particularly in respect to the amount of water required and the effect of the diversion on the sewage purification necessities of the Chicago Sanitary District.

General Taylor's letter includes a review by him of the report of the Board of Engineers for Rivers and Harbors which is signed by Brig.-Gen. Edgar Jadwin, assistant chief of engineers, both of which are based on the primary report of Major Rufus W. Putnam, district engineer at Chicago. Major Putnam's report is reviewed by Col. Spencer Cosby, division engineer of the Lakes Division. Major Putnam's report contains a number of extended appendices which are referred to but which do not accompany General Taylor's letter of transmittal to Congress.

The canal under consideration is the projected navigable way from Chicago to the Mississippi via the Chicago and Illinois Rivers. The Illinois River is under improvement by the United States in accordance with a project providing for a channel 7 ft. deep from its mouth to La Salle, a distance of 223 miles, to be obtained by two federal locks and dams and by dredging. There are two other locks and dams in this stretch of the river built, operated and maintained by the state of Illinois. The Chicago drainage canal which has turned the course of the Chicago River has a navigable channel 21 ft. deep to a point near Joliet and the state of Illinois has under construction the so-called Illinois Waterway which will provide a 9-ft. channel (with a flow from Lake Michigan of 10,000 sec-ft.) to Utica. The section of the river 7.4 miles long between the lower end of this waterway at Utica and the upper end of the improved Illinois River in the south has never been under improvement by the United States and it has a minimum low-water depth of about 4 ft.

Questions Answered—The Congressional resolution concerning this waterway contained the following questions:

(*a*) What are the estimated costs of constructing channels, each 200 ft. wide, and 7, 8, and 9 ft. in depth, respectively, in the Illinois River between Utica and the mouth, including separate estimates for each of these channels upon the basis of assumed diversions of water from Lake Michigan of 2,000, 4,167, 7,500, 8,500, and 10,000 cu.ft. per sec.?

(*b*) What depth and width of channel in the Illinois River would be most suitable for navigation purposes?

(*c*) What diversion of water is necessary from Lake Michigan for a channel of these recommended dimensions?

(*d*) Upon the assumption that all funds for the purpose are available, when can the Sanitary District of Chicago have in operation sewage treatment plants capable of treating the sewage with the amount of water necessary for navigation in the channel recommended?

General Solution—In his introductory statement, Major Putnam answers these questions categorically as follows:

The district engineer considers that the most suitable channel for navigation purposes in the Illinois River would have a least depth of 9 ft., and a least width of 200 ft.;

improved to these dimensions by retaining the two federal locks and dams with minor alterations, by removing the two state dams, and by dredging. He finds that an annual average diversion of water from Lake Michigan of not to exceed 4,167 cu.ft. per sec. (measured at Lockport) will be necessary to carry out the improvement recommended. The first cost of this improvement will be $2,261,600, the annual maintenance cost $133,485. With an average diversion of 4,167 cu.ft. per sec., the Sanitary District of Chicago will require seven years' time in which to complete and put in operation sewage treatment plants capable of treating the excess pollution, assuming all funds for such purpose available.

Preferred Canalization—Major Putnam's report goes very thoroughly into the reasons for the specific answers which have been made to these questions and the review by the Board of Engineers for Rivers and Harbors further amplifies the study in some particulars. However, the general conclusions of the two reports are well epitomized in the review by General Taylor, which is given here, with extracts from the other reports.

For any of the three depths referred to in the resolution, the river can be improved by two or more of at least four different methods, viz., (1) complete canalization, using five locks and dams; (2) partial canalization, using the four existing locks and dams; (3) partial canalization, using the two existing federal locks and dams and paritally removing the two state dams; and (4) open-channel improvement, involving partial removal of all four dams. The following condensed table shows costs for a 9-ft. channel:

	Flow at Lockport (Sec.-Ft.) Max. Annual Average	Flow at Lockport (Sec.-Ft.) Navigation Basis	Project Depth, 9 Ft. — Annual Costs — First Cost	Maintenance and Operation	Gross, Including Interest On First Cost
Complete canalization.....	2,000	3,300	$2,618,715	$216,300	$321,048
Open channel for 7 ft.; partial canalization for 8 ft. and 9 ft.....	4,167	6,050	2,261,600	133,485	223,949
Open channel.....	7,500	10,050	1,540,000	76,301	137,901
Open channel.....	8,500	11,250	1,320,000	70,125	122,925
Open channel.....	10,000	13,050	990,000	62,700	102,300

The district engineer, as a result of a careful economic study, is of the opinion that the most suitable dimensions are a governing depth of 9 ft. and a governing width of 200 ft. The division engineer concurs in this view. The Board of Engineers for Rivers and Harbors also concurs, on the basis both of the district engineer's computations and of the general significance of a navigable connection between Lake Michigan and the Mississippi as an important part of the future system of trunk-line waterways in the interior of the country.

On the basis of the data in the reports of the district and division engineers, the board states that the least possible diversion which will permit 9-ft. navigation at all times in the Illinois River may be taken as approximately 1,000 cu.ft. per sec. annual average and 1,650 cu.ft. per sec. instantaneous maximum, based on the worst navigation conditions of record in the Illinois River. This figure is approximate only, since it involves complete canalization of the Illinois and is computed on the flow necessary for lockages, with due allowance for seepage, evaporation, etc.; and computations on lockages necessarily turn on assumptions as to the future traffic.

The board points out that the question of the time required for the Sanitary District to put in a sewage treatment system turns essentially on an arbitrary definition of the degree of purity which is to be required in the waters into which the sewage effluent discharges and the point on the drainage canal or the Illinois River where this degree of purity is to be required. The arbitrary assumption made by the department for the purpose of this report was such that there should be no appreciable nuisance in the Illinois or Des Plaines Rivers due to Chicago sewage. The board points out that, on any such assumption as this, it is possible to compute in a general way the cost of the necessary works; but that it is not within its knowledge or purview whether the authorities concerned will be prepared to tolerate less favorable conditions, or if so, how much less favorable? The board further points out that, even with Chicago's sewage handled satisfactorily according to any standard which may be chosen, there would still be a material nuisance in the river due to other sources of pollution.

On the standard above adopted, a study was made, with the assistance of a firm of expert sanitary engineers [Alvord, Burdick & Howson, of Chicago] retained for the purpose, of the character and cost of appropriate sewage treatment works with various diversions. Its results are contained in the district engineer's report, from which the following is abstracted:

Sewage Treatment Program—It is evident that any program of sewage treatment should look to restoration of better conditions in the Des Plaines and upper Illinois Rivers. Almost universally, public sentiment is rapidly forming against further pollution of streams and is going to require the removal of most of it as soon as practicable. For this reason, in planning the necessary works for the Sanitary District of Chicago, it was felt wise to assume that a material improvement of conditions in these streams would be one of the objects to be attained, and accordingly an investigation was directed along the lines of determining a reasonable pollution standard.

The consulting engineers are of the opinion that no appreciable nuisance will result if the following standard is maintained:

> The liquid discharged by the drainage canal, as evidenced by the average of representative samples taken for any 30 consecutive days, shall (*a*) be practically free from solids deposited in two hours; (*b*) shall contain not less than three parts per million of oxygen and enough to equal or exceed the biochemical oxygen demand of said liquid for five days when incubated at 20 deg. C. •

Whether adherence to this standard will produce exactly the results desired or not is unknown, but in view of the present extremely unsatisfactory conditions prevailing with upward of 4,000 cu.yd. of settleable solids being dumped into the Illinois each day, and with periods of several months each year with no oxygen whatever present in the effluent, there is no question but that conditions will be improved materially. It should be understood that other sources of pollution are contributory to the Illinois River, and that with no contamination whatever from the Sanitary District of Chicago, conditions in the Illinois will not be satisfactory until the rest of the communities now discharging their sewage into the system carry out satisfactory sewage treatment programs of their own. It so happens that the adoption of a standard such that no appreciable nuisance will result carries with it the restoration of conditions which will permit fish life to thrive.

The next questions asked the consulting engineers have to do with the determination of the methods, extent, and costs of sewage treatment applicable for each of the flows in the canal. The following summarizes their findings as regards construction costs for 1935 capacities:

	Cubic Feet per Second			
Annual average flow at Lockport.....	4,167	6,000	7,500	8,500 and 10,000
Cost of construction of sewage - treatment works.....	$69,213,520	$68,726,620	$61,477,920	$57,415,240

The consulting engineers are of the opinion that no methods of sewage treatment known to be practicable will maintain the pollution standard unimpaired if the gross average flow at Lockport is as low as 2,000 cu.ft. per sec. The combined oxygen demand of the effluents from plants providing the most complete practicable treatment known is considerably in excess of the supply available in 2,000 cu.ft. per sec. For small-scale operations, sand filtration has been known to provide practically 100 per cent treatment, but the consulting engineers doubt the efficacy of this method on as extensive a basis as would be required for Chicago's sewage, particularly with practically no diluting water available as a factor of safety.

For very low diversions it would be possible to conduct the effluents from the sewage-treatment plants through tunnels to an outfall located far out into the lake, remote from the water supply intakes. The advisability of such a procedure is doubtful, in view of the large population involved at Chicago, and the costs would be excessive.

For purposes of illustrating the difficulties in the way of providing adequate sewage disposal for the lower diversions the following are the costs estimated:

	Annual Average Flow at Lockport (Cu.Ft. per Second) 3,000	2,000	1,000	0
First cost of sewage disposal by sand filtration	$111,956,860	$112,434,660	$137,670,240	(1)
First cost of disposal of effluents in Lake Michigan	141,463,520	153,413,520	174,038,520	$205,813,520

[1] Impracticable.

The operating costs are correspondingly high.

From the cost figures obtained, and from a consideration of the time necessary to plan and execute the works, the district engineer estimates that seven years would be necessary to have in operation works not involving the use of sand filtration, i.e., works corresponding to a diversion at least as low as about 4,000 cu.ft. per sec. and probably somewhat lower. For works involving sand filtration he estimates on the same basis that the time required would be ten years. The division engineer and the board concur in these approximate time estimates.

Recommendations—The district engineer recommends a 9-ft. channel 200 ft. wide, to be obtained by an annual average diversion of 4,167 cu.ft. per sec. and a maximum instantaneous diversion of 6,050 cu.ft. per sec., both measured in the drainage canal at Lockport, the channel to be provided by dredging, partial removal of the two state dams, and retention and alteration of the two federal dams, at an estimated cost of $2,262,000, with $133,000 annually for maintenance. The division engineer submits certain comments on the amount of diversion required for navigation. Taking all factors into consideration, he concurs in the recommendations of the district engineer as to the works to be undertaken, and considers that the diversion at Lockport should not exceed 4,167 cu.ft. per sec. annual average.

The Board of Engineers for Rivers and Harbors reviews briefly the history of the diversion at Chicago. It points out that the amount of this affects various important interests. These interests, and their relation to the problem, are briefly as follows:

(*a*) *Navigation*—This is of immense volume and importance; the annual tonnage of freight on the Lakes, disregarding Canadian coastwise trade, is in the neighborhood of 125,000,000 tons per year, and careful studies indicate that its benefit to the nation in direct savings is at least $125,000,000 per year, sufficient to amortize annually the entire first cost of the federal government of works of channel improvement on the Lakes and their connecting channels. Diversion at Chicago lowers the level of the Lakes and thereby reduces the depths in harbors and channels and the amount of freight that can be carried on large freighters. It has been estimated that the loss on this amount is about $325,000 per year for each 1,000 cu.ft. per sec. diverted.

As the diversion is decreased, the state must expend more money to provide a 9-ft. channel. Reduction from 10,000 cu.ft. per sec. to 4,167 cu.ft. per sec. (annual average) will cost the state about $1,200,000. Further reduction will increase this.

Increased flow in the Illinois will benefit the Mississippi channel below Grafton. The benefit will be confined to low-water months and has probably been overestimated at times; nevertheless it will exist. Its amount can not be stated without careful study.

Power—Water diverted down the Illinois is available for producing power along the Illinois waterway; there is a plant at Lockport, and others are planned. If the same water be retained in Lake Michigan it will ultimately flow down the Niagara and St. Lawrence Rivers. Under existing conditions, water which is thus retained in the Great Lakes instead of being diverted will produce no material power, since the plants on the Niagara River are already using all the water permitted by the treaty of 1909. If more diversion at Niagara is ever permitted and power plants are built on the St. Lawrence, then water will produce several times as much power if it flows by natural channels to the sea as it will if diverted down the Illinois.

The board points out that data are not at hand to evaluate these interests accurately, but that developments and investigations are under way which will tend to this end. For the present the board is unable finally to give an opinion as to the exact amount of diversion which would result in the maximum of benefit to the nation as a whole, taking all factors into account. It therefore feels that it would be premature and undesirable finally to fix the amount of the diversion at this time. It is needless to do so from the point of view of the present problem, since, as shown above, a satisfactory 9-ft. channel can be provided in the Illinois River by any one of several methods over a wide range of possible diversions.

Estimates for work done under existing conditions of diversion must be based on the special conditions arising from low lake levels and from the current practice of manipulating the flow primarily in the interest of sewage disposal. Under these conditions the estimated first cost is $1,349,000 by partial canalization.

The board therefore recommends modification of the existing project for the Illinois River to provide a channel with least dimensions of 9 ft. in depth and 200 ft in width from the mouth to Utica, by dredging and by the partial removal of the two state dams and the retention and minor alteration of the two federal locks and dams, at an estimated cost under present conditions of diversion of $1,350,000, with $126,000 annually for operation and maintenance.

War Department's Position—The board states that the position of the War Department in the matter of the diversion at Chicago is set forth in the documents connected with the issue of the permit of March 3, 1925, namely, that every effort should be made to restrict the amount of diverted water. The board, in its present report, is concerned primarily with providing an immediately workable scheme of navigation in the Illinois River, and hence has based its estimates on the actual existing diversion, which is approximately 8,250 cu.ft. per sec. It invites attention to the fact that it does not recommend this as the final figure; the work it proposes will be useful in any future project that may be based on a lesser diversion.

There are many facts which have a bearing on the matter of the amount of diversion, among these being the successful and economical operation of the immensely important commerce of the Lakes, whose magnitude and benefits far exceed those of any probable commerce now foreseen on the Illinois River and waterway. It has been shown by the present investigation that the amount of the diversion is not a governing factor in providing a 9-ft. channel on the Illinois, as the amount can be varied within wide limits and still leave such a channel entirely practicable, though its costs would be increased as the diversion decreases. The problems in question are in process of investigation and it is hoped of orderly settlement. For the present, therefore, the board does not recommend that any final figure for the diversion should be set; nor that any change be now made in the policy with respect to the proper ultimate diversion.

After due consideration of the above-mentioned reports, I concur in the views and recommendations of the board.

(*Signed*) H. TAYLOR,
Major General, Chief of Engineers.

Railroad Program for Colombia, S. A.

A five-year public works program of $48,000,000 announced by the minister of public works for the Republic of Colombia, South America, comprises the following items: Northern Central R.R., 200 miles, $9,000,000; Bocas de Ceniza, $3,500,000; Narino R.R., to Altaquer, 55 miles, $3,000,000; Carare R.R., 55 miles, $2,500,000; aerial trainway, Cucuta to Gamarra, $2,500,000; Bolivar Central R.R., 66 miles, $2,500,000; Huila R.R., 50 miles, $2,000,000; Pacific R.R., Zarzal to Armenia, 38 miles, $2,000,000; and to Popayan, 25 miles, $1,200,000; Southern R.R., 30 miles, $1,500,000; Quindio R.R., Nacederos to Armenia, 30 miles, $1,500,000; first section of Choco aerial trainway, $1,200,000; completion of dock canal, $1,000,000; Santander R.R., 18 miles, $600,000; subsidies to departmental railways, 200 miles, $6,000,000; total $40,000,000; emergency fund, 20 per cent, $8,000,000. Grand total, $48,000,000.

Observance of Licensing Law Sought by N. Y. Engineers

Permanent Committee Appointed by Buffalo Section of Am. Soc. C. E. to Report Violations to Proper State Officials

THE DEGREE of observance of that portion of the General Business Law of New York that applies to the licensing of professional engineers and land surveyors has recently been investigated and reported upon by a special committee of the Buffalo Section of the Am. Soc. C. E. In addition to reporting upon conditions as found, the committee recommended the appointment of a permanent committee in Erie County to watch for violations of the law and report them to the proper state officials. According to S. J. Stone, president, Buffalo section, it is expected that the committee will be operating by about April 15 along the lines recommended in the report. Copies of the report are being sent to the other New York sections of the society with the request that these sections take some action along similar lines.

The portion of the general business law relating to licensing of professional engineers and land surveyors was affixed as an amendment in 1920. After several revisions and additions, it became operative in its present particulars in 1923. Most of the amendments provided exemption to certain classes of engineers and land surveyors and were generally acceptable to the several engineering societies of the state, according to the report. However, the committee states that in two cases of exemption, that for men in the employ of towns or counties where contemplated projects do not exceed $5,000 and that for men in the employ of corporations engaged in interstate commerce, it is unable to say that any considerable number of the professional engineers or land surveyors of the state are favorable toward them.

The committee finds that the State Regents of New York who are charged with seeing that the law is enforced are living up to their duties under the law in all but one particular. They are required in the month of January in each year to file, with the county clerk of each county in the state, a complete roster of the professional engineers and land surveyors as of the first of that year. This they have not done. However, a board of examiners has been appointed by them which is carrying out its duties as outlined. The State Regents are empowered to revoke certificates when necessary, but to the committee's knowledge no certificates have been revoked since no cause for such action has ever been presented.

In a word, the only effect of the operation of the law, so far as the committee could find, has been the collection by the state of fees on the original issuance of a license and for renewal the first of each year. An almost complete indifference was found to exist among professional engineers as to the law or the benefit of being licensed. The committee also found that the use of the term "license" in place of "registered" does not seem to add any dignity to the official title and recommends that the latter term be employed.

Since it was also found by the committee that the registered engineers have not established any agencies as have the architects and realtors, whose duty it shall be to refer to the State Educational Department violations of the law or malpractice on the part of unregistered engineers, the committee recommended that "The president of the section shall appoint a permanent committee, all of the members of which shall be licensed professional engineers and whose place of business shall be in Erie County and one of this committee to be engaged in private practice and one to hold a license as a professional land surveyor."

In general, the duties of this committee shall be as follows: (1) To confer with Erie County members of the A.S.M.E., A.I.E.E., and A.I.M. & M.E., inviting these bodies to appoint three licensed professional engineers to serve on a permanent committee, of which the A.S.C.E. committee shall be a part. The resulting Grievance Committee shall be financed by appropriations from the participating sections as represented on it. (2) In case any or all of the other founder societies shall not appoint their representatives within one month from March 9, the A.S.C.E. members shall be empowered to select sufficient members to complete a membership of 12 in all. (3) In general the duties of the Grievance Committee shall be to secure action from the State Examining Board and Educational Department on frozen applications, to report to the Department of Education infractions of the law and to broadcast general information to the public. (4) Within one month after the date of its permanent organization, it shall be mandatory on the Grievance Committee to do the following two things: (a) Publish in newspapers in the county a suitable advertisement to the effect that instances of violations of the law are requested and that such relative information will be treated in strict confidence as far as its source is concerned. All instances reported shall be investigated and later referred, if necessary, to the State Department of Education. (b) Inform the State Board of Education and the Examining Board of its existence and duties within one month after the date of its permanent organization.

The members of the special committee making this report and these recommendations to the Buffalo Section were John P. Kelly, chairman; John H. Feigel; and Harold E. Plumer.

Change to Excess Chlorination of Sewage Advised

Inspection of sewage-works where chlorination is used for bacterial reduction, made in 1925 by the Division of Sanitation of the New York State Department of Health, according to *Health News* of March 8, showed unsatisfactory results, especially during the summer months. Continuing, the journal named says: "These plants were being operated on a fixed chlorine dosage. This led to experiments to determine whether sewage disposal plants could be operated on an excess chlorine basis in like manner to water purification plants. While this experimental work has not been completed, sufficient data have been obtained to determine that a sewage effluent in which an excess of 0.5 p.p.m. of chlorine has been added, as indicated by the orthotolidin test, will show a very satisfactory removal of bacteria with a 15-min. detention period. A method has been developed for applying the test to sewage. By its use a plant operator may determine within half an hour whether a satisfactory effluent from a bacterial standpoint is being obtained."

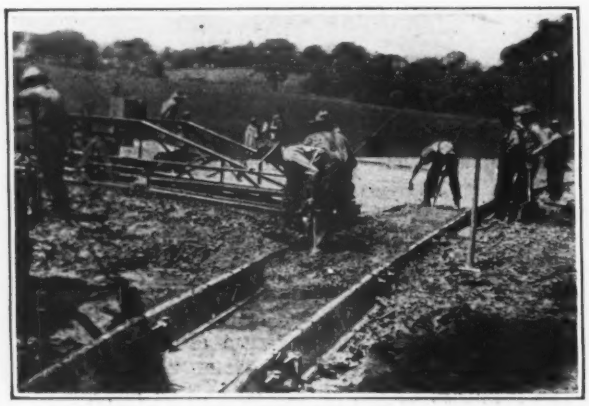
From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Finishing Widened and Flattened Curves with Mechanical Road Finisher

By E. Warren Gotwals
Assistant Project Engineer, Missouri State Highway Commission, Maryville, Mo.

About the time of the completion of Federal-Aid Project 265-A, in Nodaway County, Missouri, an article was published in *Engineering News-Record* pertaining to the finishing of widened curves with a mechanical finisher. (March 26, 1925, p. 532). As the idea appealed to the engineers and the superintendent, and to ascertain if it was practical, they decided to try it out on two curves on this project. As the article in *Engineering News-Record* did not go into detail, and as the method was successful, this article is submitted



USING FINISHER ON WIDENED ROAD CURVE

in the hope that it may aid some one else under similar conditions.

The Missouri standard concrete section is the type 9:6:9 section, 18 ft. wide with a 1.5-in. crown. The curves under consideration were both 29 deg. curves, were separated by about 35 ft. of tangent, and curved in opposite directions. The radius and superelevation on these curves had been reduced due to the fact that they are in the city of Maryville and connect this project with the city street at this point. On curves of this radius we finish the slab flat across and widen 4 ft. on the inside at the center of the curve.

Our method differed from the method suggested in the initial article in that we did not use wood or light steel channels for the inside or false form. We were using standard Metaform steel forms for this project and they were used for both inside forms. Where the false form left the outside form on the inside of the curve, treatment similar to a stub switch was used. That is, the last section of form before the widening began was arranged to connect with either line of forms on the widened part. The thickened edge gave us some trouble at first, at the point where the widening began, but that was solved by the simple expedient of building the 18-ft. section of slab standard, and making the widening a uniform depth of 9 in. Concrete was deposited for the full width of the pavement, on both sides of the inside or false form. The 18-ft. section was thoroughly tamped and finished by the machine, which was then moved ahead, the false form pulled, and the extra width then finished by hand. The flat surface was obtained by bolting straight pieces of 2x4 to the strikeoff and tamper of the finisher. As the distance around the two inside forms was not the same, there was a short section on the end of each curve where a standard section of form would not fit in both lines of forms. A piece of 2x9 was used to close this gap in the outside form, on the inside of the curve.

The work was under the supervision of N. N. Ropes, project engineer, and M. N. Windle, superintendent for the C. H. Atkinson Paving Co., who were the contractors. The writer laid out the curves and checked the formwork.

Adding Seven Stories to a 12-Story Building

Building a seven-story extension on top of a 12-story steel-frame office building and carrying out interior alterations without material interference with the tenants or with street traffic is an interesting piece of building work now being carried on at the Standard Oil Building, Chicago. No foundation work is involved, as the building was designed for nineteen stories and is supported on concrete piers sunk to bedrock. For the same reason, no reinforcement is required in the structural frame, except in one case, as noted below. The roof also was built originally to form the future 13th floor, being covered temporarily with cinders shaped to drainage planes and finished with a tar, felt and gravel roofing.

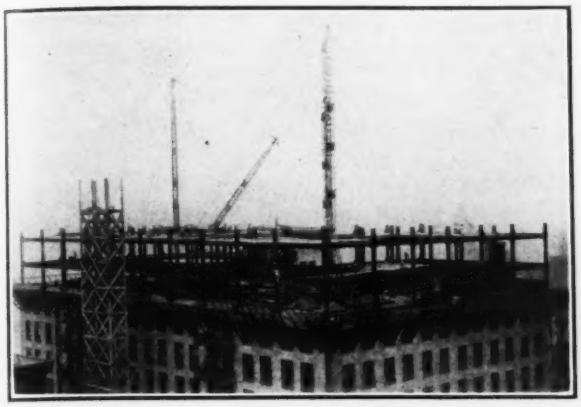
The main work, therefore, is the erection of a seven-story steel structure above the present roof, placing the tile-arch floors and new roof, and building the brick and terra cotta walls, besides placing the interior finish and equipment. This erection work is clearly shown in the accompanying view, as it stood on Dec. 8, 1925, with the steel frame erected for the first two new stories.

Two steel guyed derricks, with 110-ft. masts and 100-ft. booms, serve the entire area; they hoist the steel members from the street as well as place them in position. The heaviest loads handled are about ten tons. Brick, tile, mortar and other materials are hoisted in a four-cage tower erected on the Ninth St. side of the building. There is only light traffic on this street, so that the building plant on one side of the street makes little obstruction; the sidewalk is kept open.

A working platform with protection screen to prevent bricks, tools or material dropping to the street was built on the outside of the building just below the roof line, as shown in the view. At each window opening two 3x8-in. raking struts were set on the sill, and held by horizontal planks of the same size which entered at the top of the window and were secured to a timber laid upon their ends and against the wall. The

upper sash had to be lowered about 12 in. for this purpose; the space above the sash and between the planks being closed with plank and roofing paper. Upon the horizontal planks was laid a floor of 3-in. plank, with similar planks against the struts. Above the struts was a wire screen about 4 ft. high.

The one important structural alteration or reinforcement was in the main front on Michigan Ave. Here



BUILDING NEW STORIES ON A SKYSCRAPER

the front columns extended originally from the first to the third floor without intermediate support, and it was considered desirable to provide additional support and wind bracing. In the original construction, these columns were enclosed in masonry faced with fluted granite; the store fronts were in reveals or recesses between the masonry columns and behind the line of the steel columns. All this masonry was removed, exposing the steel columns. New spandrel girders with large gussets for wind bracing were then fitted between the steel columns at the second floor level.

The former reveals or recesses are thus eliminated, and the first and second floors are extended to a new front a little in advance of the line of columns. The new windows and walls will be put in for these two stories in front of the original construction, the latter being then taken out and the necessary flooring and partitions built to connect the new and old work.

To provide additional elevator capacity in the enlarged building, six new elevators are being installed. Three of these, running to the 19th floor, are placed adjacent to the original battery of six elevators, all of them occupying what was formerly a stair shaft. The other three, running to the 12th floor, are in a new shaft on the opposite side of the entrance corridor. This shaft, large enough to accommodate a new stairway, had to be cut through the building from top to bottom, requiring some alterations in the original steel floor framing.

Although these shafts extend through what was formerly office space, and necessarily reduce the size of certain offices, their construction causes little trouble to tenants, as the contractor has erected tight temporary partitions or bulkheads to enclose the working space. In connection with the work on the elevators, the old open grillwork and doors of the elevator shaft are being replaced with solid tile walls having hollow-metal doors with wire-glass panels. This provides fire protection, as there will be no open communication between the shafts and the building. Elaborately finished private offices, board rooms and other special facilities for the Standard Oil Co. will be provided on the top or 19th floor.

The architects for these extensive additions and alterations are Graham, Anderson, Probst & White. The contractor for the entire work is the John Griffiths & Son Co., the planning of the methods and execution of the work being directed by J. C. Ruettinger, general superintendent.

Alumina Cement Used in Repair of Dredge Hull

By William M. Acheson
Division Engineer, New York State Department of Public Works

QUICK-HARDENING cement was used effectively in the hull of the *Pathfinder*, a 2½-yd. dipper dredge with a wooden hull in use on maintenance work on the New York State Barge Canal. The original hull has deteriorated to such an extent that it is to be replaced by a new steel hull. In the meantime every effort has been made to carry the present hull along to keep the equipment active. In August last a section of the hull, 14 in. x 26 ft., went out. Examination of the timbers showed the impracticability of attempting to frame a new wooden section. New ribs would have been required and the dredge would have been out of commission for a large part of the active construction season. A concrete plank was therefore cast where the old timbers had gone out and alumina cement was used.

The derrick was swung to tilt the dredge and keep the

SECTION OF DREDGE HULL REPAIRED WITH CONCRETE

part to be repaired above the water surface. The rotted timbers were removed and forms were built up about the opening to shape a concrete plank to overlap the abutting timbers both outside and inside of the hull. Steel rods, 1½ in. in diameter, were used as reinforcing. Two days were required to make ready for the operation. Alumina cement was used in a 1 : 1½ : 3 mix. The dredge was ready for service 24 hours after concreting. There has been a slight leaking about the joints which may be accounted for by the shrinkage of the cement. Since that repair the dredge has worked continuously, handling 600 to 1,000 cu.yd. daily. The work was done in Division 3 under the direction of Guy W. Pinck, resident engineer.

Truck, Carrying Own Material and Equipment, Repairs Any Road

EQUIPPED with an air compressor, air receiver and hose, bins for cement, sand and gravel or rock, a concrete mixer and oil-heating tank, a water tank and a spray painting outfit as the principal accessories, a combination heavy-duty truck in operation in California is ready for any kind of highway maintenance. The truck shown herewith is the latest of three to be built, all three being much alike in design. By use of this equipment, which also serves as a portable power plant and supply station, a crew of three men can control many miles of pavement, taking care of each failure on any kind of road before it assumes serious proportions.

The outfit consists of a heavy-duty motor truck equipped with an air compressor with a capacity of 80 cu.ft. per minute, air receiver and 200 ft. of 1-in. air hose. There are combination material bins with capacities of 1,000 lb. of cement, one cubic yard of sand, 2 cu.yd. of gravel or rock, all bins being controlled by hand-operated gates delivering to a mixing apron.

There is a concrete mixer driven by an auxiliary shaft from the transmission, a 150-gal. water tank arranged to discharge either by gravity or air pressure and a centrifugal pump with a self-priming device and

MULTIPLE-DUTY TRUCK FOR ROAD MAINTENANCE

suction hose for filling the tank from wells or rivers. A drawbar attachment provides for hauling trailers and still greater pulling power is provided by a winch.

A 50-gal. road oil heating tank with gas burners is provided including a siphon nozzle for spraying bituminous material. Small tools are carried, such as pneumatic jack-hammer with assorted chisels, tampers, etc., a pneumatic post hole digger, a spray painting device, stencils for lettering signs on the pavement, etc.

Beveling or other grading or drainage work along dirt roads can be done by the use of a grading plow or grader, towed by a line from the extension side arm of the truck. Standard equipment includes a steel wheelbarrow, one 10-ton jack, 200 ft. of 1-in. Manila rope, 25 ft. of tow chain, shovels, picks, crowbars, sledge hammers, red lanterns, etc.

In short, the intent has been to equip the truck with power-operated labor-saving devices so that a small crew can quickly perform functions that would otherwise require more time and special trips. It is stated that the truck has been found useful for many purposes not contemplated by the original program. For example, spraying trees with fungicide, putting out fires along the highways and pumping out caissons in sewer or bridge construction.

From Job and Office

Hints that Cut Cost and Time

One of these trucks is used by the road supervisors in Kern County, California, a second by the San Diego Electric Railway Co., and a third by the Colorado State Highway Commission. The trucks are built by the Fageol Motors Co. of Oakland, Calif. The prices range around $9,000 or $10,000, according to the equipment specified.

Turning Radius of Automobiles

By Lynn Perry
Department of Civil Engineering, Lafayette College, Easton, Pa.

IN DESIGNING garage doors on narrow streets and locating columns in large garages, it is frequently desirable to have data on the room required for an automobile to make a turn. Since this information was not available in combined form, the author has gathered and correlated it as shown herewith.

Specifications issued by some automobile and truck manufacturers contain the wheelbase and occasionally, the turning radius. In making the chart this information, when obtainable, has been checked by measurements and when not obtainable has been measured in enough cases to warrant assuming an average.

It is logical to believe that there is some relation between the wheelbase and the turning radius and this set of measurements has been made to discover and plot

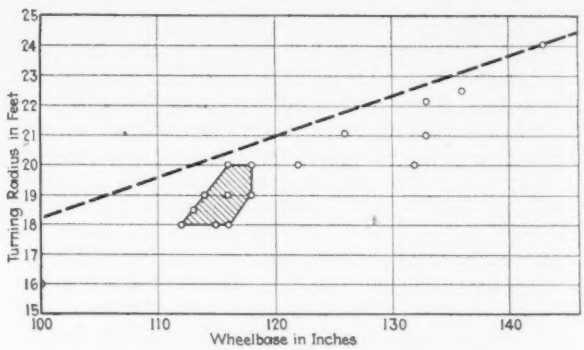


CHART SHOWS RELATION OF WHEELBASE AND TURNING RADIUS

this relation if it does exist. There is some variation in the turning radius of some cars of the same model and make and there is an adjustment in the turning radius of some cars. Generally, trucks of the same wheelbase turn on a shorter radius than do passenger cars. These observations have been made on 18 cars and trucks varying from a 100- to a 143-in. wheelbase and from a 16- to 24-ft. turning radius. Seventeen of these are plotted on the accompanying diagram (two being identical, one does not show). This relation in a large percentage of the most popular makes of cars and trucks falls inside of the hachured area. The line as drawn on the diagram gives a factor of safety of 1 ft. (in all except one case) which is ordinarily sufficient clearance for careful drivers.

The present tendency is for cars, particularly of long wheelbase, to shorten the turning radius. The longer the wheelbase, the more pronounced this tendency ap-

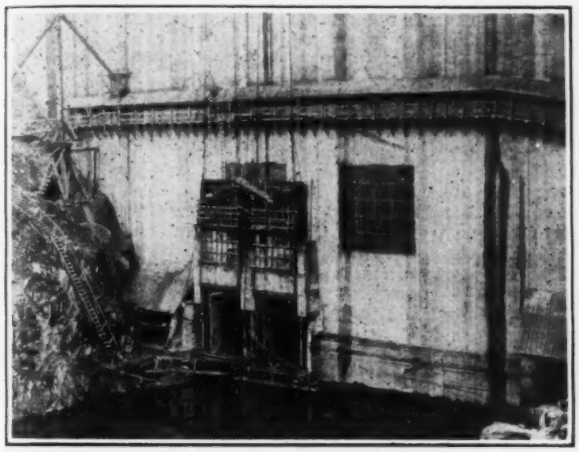
From Job and Office

For Contractor and Engineer

pears. The relation between wheelbase and turning radius is not a straight-line relation, necessarily. Nevertheless, this line serves the purpose of the designer very satisfactorily.

Roofed Manway a Safety Feature on Exchequer Dam

IN THE construction of the Exchequer dam on the Merced River in California it was necessary to provide a manway for workmen along the upstream face of the dam. In order to prevent falling objects from striking men using the manway a roofing was put over it consisting of 2-in. planks set at a very steep pitch



MANWAY ALONG UPSTREAM FACE OF EXCHEQUER DAM

with the upper ends beveled to fit the face of the dam snugly thereby excluding leakage.

The roofing planks are nailed to 2x6-in. horizontal pieces which in turn are spiked to 2x6-in. posts at 8-ft. intervals which rise from both sides of the manway. The only anchorage into the concrete of the dam is in the supporting brackets spaced on 4-ft. centers which are made of 4x6-in. timbers each fastened to the concrete with two 1-in. bolts.

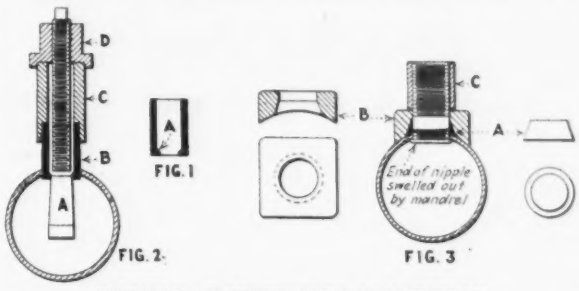
For the foregoing *Engineering News-Record* is indebted to M. H. Slocum, superintendent for Bent Bros., Inc., who hold the contract for building Exchequer dam.

Simple Connection to Steel Mains

By F. Johnstone Taylor
Fiddlers Ferry, Warrington, England

ONE of the virtues of steel pipe for water or gas is its lightness, springing from the fact that thin walls will withstand considerable pressure. This thin wall is usually unsuited to a simple tap which is common practice in the use of cast-iron mains. The system outlined herein has been devised for making small connections to steel pipe.

The essential part of the connection is the specially shaped nipple as indicated in Fig. 1. The shorter of the screwed ends is inserted into the main and the internal bulbed rim *a* should be noted. With the necessary hole bored and tapped the taper mandrel *a* (Fig. 2) is lct into the pipe, the nipple *b* is screwed home, the sleeve *c* is screwed onto the nipple and the nut *d* screwed on to the



DETAILS OF STEEL PIPE CONNECTION

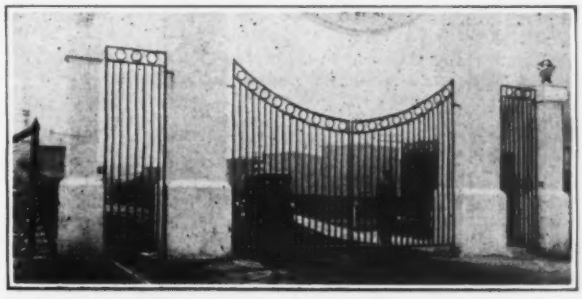
threaded portion of the mandrel until the latter is in the position shown. As the mandrel is tapered it can be drawn through the nipple by seven or eight turns of the nut.

The internal bulbed rim *a* (Fig. 1) disappears and the short external portion of the nipple thread which actually extends into the pipe is swelled out in the same way as it would be if riveted over by a ball peen hammer so that it cannot possibly be pulled out.

The third stage of the connection is shown in Fig. 3. A gutta percha ring *a* is first placed over the nipple, the saddle *b* is screwed down tight by the socket *c* and the whole forms a strong and completely protected connection.

Job and Office Notes

Scrap Metal Which Years Ago Would have been junked has recently been made usable by oxyacetylene welding. The transformation of scrap into something useful is indicated in the accompanying photograph. An industrial firm with a large scrap pile had occasion to build a strong yet more or less decorative fence and gateway. Sketches were



made and work started. The first step consisted in providing pipe of correct diameter to the proper length, which was readily done with the cutting blow-pipe. With sufficient material of usable lengths on hand, assembling began. The fence was made with all joints welded and heavy wire netting was used for fence covering between posts. To attach the netting to the posts, U-shaped cuts were made in each post with the cutting blowpipe and the tongue formed was bent inward over strands of heavy wire. The gateway was constructed by selecting carefully graded lengths of pipe and welding them to a straight supporting crossbeam of heavier pipe. Two bent pipe lengths rounded over the top of each arch gate. Then cross-sections of large-diameter pipe were cut with the blowpipe and these, welded at intervals along the top of the gates, added to the general appearance. The information contained herein was supplied by H. G. Edwards of the Linde Air Products Co., New York. The gateway and a small portion of the fence are shown in the accompanying photograph.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Speed of Cable Spinning

Sir—In reading the article "Suspension Bridges and Their Cables," which article is a review of a monograph issued by John A. Roebling's Sons Co., entitled "Construction of Parallel Wire Cables for Suspension Bridges," appearing in your monthly review of books of Feb. 18, p. 290, I note that the last paragraph, in comparing the progress made in cable spinning since the time of the Brooklyn bridge, states that the operation of cable spinning took 3½ months for the Bear Mountain bridge as compared with 21 months for the Brooklyn bridge, and 7 months for the Williamsburg bridge.

I assume that the figures given are for the actual spinning of the wires for the cables, in which case the time given for the Bear Mountain bridge is in error, as my records show that the first wires were spun on June 8, 1924, and the final ones on Aug. 22, 1924; making the time almost exactly 2½ months.

HOWARD C. BAIRD,
Consulting Engineer.

New York City,
March 3, 1926.

Chance and Fate as Flood Factors

Sir—On p. 374 of *Engineering News-Record* of March 4 J. G. Sullivan gives some valuable flood data for the Red River of the North at Winnipeg, Man.

Whether as Mr. Sullivan contends, the removal of forests, cultivation of the soil, digging of ditches, etc., tend to increase the magnitude of minor floods and decrease the danger of ruinous inundation in cold climates; or whether the major events of this type depend for their magnitude upon the chance fall of the cards of fate must always remain somewhat problematical.

The extraordinary flood event cited as of 1826 for the Red River seems to have a parallel in the Indian tradition of a similar event sometime in the early part of the nineteenth century on the Minnesota River, the headwaters of which join those of the Red. This tradition suggests a flood stage of somewhere between six and ten feet above the flood of 1882.

Estimates by Adolph F. Meyer and the writer suggest for the Minnesota River at Montevideo, Minn.:

1919	Summer 22,000 sec.-ft.
1894	Spring 27,000
1882	Spring 32,000
1866	Summer higher by possibly a foot.
1820—40	Spring 6 to 10 ft. higher than 1882.

Over the drainage area of the Minnesota, 6,300 sq.mi., during this period the wild prairies have been reduced to cultivation, considerable shallow sloughs and ponds have been reclaimed by drainage, but the planting of timber for protection of farm buildings has produced probably some net increase in the timber area.

It will be observed that for this case there appears a fairly even balance between floods which are the result of rainfall and those that are the result of melting snow, the former being marked summer and the latter spring. The time of concentration for this area is about a week for rainfall events and around ten days for melting snow, the flow then being generally obstructed by ice and drifts.

An event probably comparable to that of 1826 on the Red River so far as the frequency of recurrence historically is concerned, is the flood in March, 1913, on the Miami River at Dayton, Ohio. This was a rainfall event and the stream has a concentration time according to the flood control investigations of three days.

The date of this event and the fact that it has not been equaled or exceeded in at least 100 years would seem to give the fate theory somewhat the best of the argument if it were not for the fact that it was caused by rainfall entirely and this brings us to the real point in the case, concentration time.

The concentration time for the Miami, three days, is too short to make snow runoff critical; the Minnesota at Montevideo hangs in the balance with about even chances of rainfall and snow runoff causing a flood, with its time of a week to ten days; and the Red River at Winnipeg with a concentration time of several weeks must consider melting snow as the one great factor in its floods.

The discharges of the Red River at Grand Forks, N. D., as estimated by Prof. E. F. Chandler of the University of North Dakota, from the navigation gage record from 1881 to 1912 are found on pp. 375 to 380 of the Report of Water Resources Investigation of Minnesota of 1909-1912 (out of print), State Drainage Commission. Some of these magnitudes are analyzed on a chance basis by the method of least squares on p. 625, Vol. LXXVII, Dec., 1914, *Transactions* of the American Society of Civil Engineers. The same data are charted in Fig. 2 on p. 537 of the U. S. Monthly Weather Review for November, 1924, on a chance relation proposed by the writer, and most of the maxima charted are the result of snow runoff.

This and other data would seem to indicate that the chance element in snow runoff is much the same as for rainfall events, and while no conclusive proof can be submitted, yet the reversal for some areas with the maximum events showing in the more modern records, would seem to make the chance, fate, risk, odds, expectancy factor the big item to be taken into account.

S. L. MOYER,
Civil Engineer.

Montevideo, Minn.,
Mar. 15, 1926.

Tests of Batten-Plate Columns Needed

Sir—The writer has read with interest the article of R. Fleming and W. H. Weiskopf on batten-plate columns in your issue of March 11. The case of batten-plate columns versus laced columns is a question of economy only. It is evident that a solid plate is better than lacing, and that lacing is better than nothing; therefore there is no doubt about the high efficiency of a series of batten plates with moderately short spaces between them. The question is only how long the interspaces are to be and how heavy the batten plates.

The writer wishes again to emphasize a suggestion made by him in an article in *Engineering News-Record*, Oct. 1, 1925, p. 546, that equivalent amounts of material and rivets should be given to the two competing systems in case of future tests—equivalent meaning also equally expensive. The open space between the batten plates may be made somewhat larger than the open space between two attachments for lacing bars, because a rivet group diminishes the effect of the eccentricity of a single rivet, and because the batten plates have not the same tendency to distort the column as has lacing.

For a column deflecting as shown by Mr. Weiskopf in his Fig. 8, the bending moment on the column as a unit is largest at the center and is an accumulation of the bending in the individual panels, which bending is largest at the ends of the column. The deflection d is therefore not a constant for all panels. The batten plates should be strongest near the ends.

A column with batten plates may perhaps require somewhat more judgment in its design than a laced column, but there are unquestionably many cases of middle-sized columns in which batten plates can be used with both safety and economy of time and work in drafting room and shop. What is needed, is a series of verifying tests.

C. F. CHRISTENSEN.

New York,
March 16, 1926.

Flow Tests in Old Cast-Iron Water Mains

The article "Flow Tests of Old Cast-Iron Water Mains" by J. B. Eddy in your issue for Feb. 18, 1926, p. 287, is of interest in providing specific and large scale examples of cast-iron water mains which have suffered a much less reduction in capacity due to age than text books ordinarily would lead us to expect. If, however, values for Hazen and Williams' coefficient of friction are taken from the table on p. 287 and plotted against the age of the pipe a downward trend in proportion to age will be noted. This downward trend, while not at all definite, is approximately at a rate of decrease of 0.3 per cent a year.

W. M. OLSON,
Sanitary Engineer, Cook County Department of Health.

Chicago, Ill.,
March 8, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

St. Louis Public Utilities Director Discharged

Mayor's Chief Charges Against Him Found Groundless—Mayor Acts on Minor Charges

E. E. Wall, director of public utilities of St. Louis, Mo., has been discharged by the mayor of that city following a request for his resignation after the mayor's hearing of the charges, which he had preferred against Mr. Wall, showed that the mayor's charges were groundless.

Charges Not Sustained

The early stages of Mayor Miller's attack upon Mr. Wall were reported in our issue of March 18, p. 461. At that time, the mayor was holding a hearing on the charges of incompetency and insubordination preferred against Mr. Wall. Subsequently, the mayor, in a letter to Mr. Wall, admitted that the hearing had not shown any incompetency or lack of integrity on the part of Mr. Wall or Mr. Toensfeldt, the electrical engineer, whom Mr. Wall refused to dismiss at the Mayor's request. The Mayor stated, however, that on four other charges, namely, making a slanderous statement about the city administration, refusal to comply with the Mayor's request to investigate a certain contract, unbecoming conduct in complaining to a local improvement association against its action, and insubordination in refusal to consider the Mayor's request for the discharge of Mr. Toensfeldt, had been found to be true. Also, the Mayor stated that Mr. Wall has not co-operated with his associates on the board, and in consequence asked his resignation. Upon Mr. Wall's refusal to resign, the Mayor dismissed him. Immediately upon his dismissal, Mr. Toensfeldt and a large part of the director's office force resigned.

During the hearing it was brought out that the other four members of the Board of Public Service, a board which includes two members of the American Society of Civil Engineers, had met at the Mayor's request to consider his charges and had recommended that Mr. Wall be given another opportunity to reconsider the Mayor's demand. The president of the board, E. R. Kinsey, is reported to have stated that the board did not see how a man who refused to comply with an order of the Mayor could be expected to remain in a position long.

New Director Appointed

Following the dismissal of Mr. Wall, the Mayor appointed John C. Pritchard, the water commissioner, director of public utilities to succeed Mr. Wall. It is reported that George B. Heath, who was discharged as superintendent of electrical construction by Mr. Wall, is to be reappointed.

Engineering Fifty Years Ago

From *Engineering News*, April, 1876

THE Delaware, Lackawanna and Western Railroad Co. are replacing many of the wooden bridges on the line of their road with iron ones.

* * *

All of St. Louis north of Washington Avenue, is going to be lighted with kerosene lamps, saving thereby $20,000 per year. St. Louisians think gas too expensive.

* * *

The track of the Chicago, Clinton and Western Railroad will be extended to Iowa City, Iowa, by July 1. It is already ironed for twenty miles beyond Cleveland, leaving fifty-five miles more, already graded, to tie and iron.

Philadelphia-Camden Bridge to Be Open to Traffic July 1

The Philadelphia-Camden suspension bridge over the Delaware River will be opened to traffic at midnight on July 1, according to plans recently made by the Delaware River Bridge Joint Commission. Celebration of the completion of the structure will be held on July 1 in place of July 4 or 5 as previously contemplated. The change of date was decided upon by the joint commission in order that the bridge might be used for the holiday traffic to seashore resorts. Traffic is expected to be unusually heavy because the July 4 holiday is a week end. The work required for completion of the bridge has been started under the contracts awarded during March.

Joint Water Supply Projected for Youngstown and Niles

The Mahoning Valley Sanitary District, made up of the cities of Youngstown and Niles, has been organized under the Sanitary District Act of Ohio for the purpose of providing a new water supply for the two cities named. The directors of the district are Jacob D. Waddell of Niles, Trumbull County, and Fred A. LaBelle of Youngstown, Mahoning County. W. H. Dittoe, now chief engineer, Ohio State Department of Health, has been appointed as chief engineer for the district. In view of the urgent demand for the new supply, the necessary preliminary engineering work will be carried out as rapidly as feasible.

No Change in Paving Brick Varieties

Simplification Committee Holds Its Annual Meeting in Washington

The Standing Committee on Paving Brick Simplification, functioning with the U. S. Department of Commerce, held its annual meeting in Washington April 1. As a result of its deliberations no changes were made in the present list of four recognized varieties.

The survey of shipments in 1925 showed that of a total shipment, (representing 96 per cent of the tonnage capacity of the industry) of 353,600,000 brick, 74.2 per cent were in the four recognized varieties. Percentages for the individual sizes in 1924 and 1925 are shown in the accompanying table.

SHIPMENTS OF RECOGNIZED VARIETIES OF PAVING BRICK, IN PER CENT OF TOTAL SHIPMENTS

	Per Cent 1924	Per Cent 1925
Plain Wire-Cut		
3 x 4 x 8¼ in.	43.1	40.7
3½ x 4 x 8¼	11.0	5.5
Repressed lug		
3½ x 4 x 8¼	22.0	21.0
Wire-Cut Lug (Dunn)		
3½ x 4 x 8¼	6.0	7.0
Total	82.1	74.2

The decline in the percentage of shipments of recognized varieties is due to the increased demand for a thinner brick. The 2½x4x8¼-in. plain wire-cut brick (not a recognized variety) showed percentages of shipments in 1923 of 2.7 per cent, in 1924 of 4.4 per cent and in 1925 of 8.9 per cent.

Increased Use of Thin Brick

Because of the evident tendency toward the use of thinner brick and because 2½ in. brick have so far stood up well in the brick road test now under way by the Bureau of Public Roads at the Arlington Experimental Station, the Committee gave careful consideration to the advisability of declaring the 2½ in. brick a recognized variety. However, the committee rules provide that, unless there are special reasons, a variety shall not be designated as "recognized" unless its shipments for three successive years have amounted to 5 per cent of the total. Lacking a unanimous vote (which the committee's rules also require) the proposal to recognize the 2½ in. brick was lost.

Due to the increased use of thinner brick it is expected that the subject will come up again next year.

No Sizes Eliminated

The committee's rules for eliminating a recognized variety require that the variety shall fall below 2½ per cent of shipments for three successive years.

Since no variety came under this ruling and there were no special reasons for changes, no eliminations were made.

TECHNICAL SOCIETIES THANKED

As a recognition of the contribution of the technical societies and the technical divisions of the government to the work of the committee the following minute, signed by the representatives of the U. S. Department of Commerce, the U. S. Chamber of Commerce, the National Paving Brick Manufacturers Association and by the chairman, was entered on the records of the committee and ordered sent to the technical societies and governmental bureaus represented on the committee:

"On behalf of the National Paving Brick Manufacturers Association, the engineering profession, the Chamber of Commerce of the United States, and the U. S. Department of Commerce, we desire on this occasion to express our hearty appreciation and thanks to the members of the Standing Committee on Paving Brick Simplification (representing as they do technical, research and professional organizations and societies) who have, for the past five years, travelled varied distances at their own expense to actively participate in the deliberations of the committee. This manifestation of interest in mutual welfare and devotion to the duties assigned them, and the placing at the disposal of the committee their expert technical knowledge, counsel and experience is, in a large measure, responsible for the singular progress and success of the paving brick simplification program. As an example of constructive action by an industry and its allied interests, this committee's work stands pre-eminent in the new order of self government in American business."

During the course of the meeting E. F. Kelley, testing engineer of the U. S. Bureau of Public Roads and L. W. Teller, in charge of the brick road tests at Arlington, summarized the results of the Arlington tests to date. E. E. Duff, Jr., secretary of National Paving Brick Manufacturers Association, reported that a questionnaire sent to the state highway departments had shown that the departments are well acquainted with the work of the committee, approve the plan of a limited number of recognized varieties, and are specifying the recognized varieties for their work.

There was 100 per cent attendance of the members of the committee. Those present and the organizations they represented were as follows: P. St. J. Wilson, Bureau of Public Roads; Col. R. K. Compton, American Society of Civil Engineers; George F. Fisk, American Society for Municipal Improvements; O. W. Renkert, American Ceramic Society; Edward E. Duff, Jr., National Paving Brick Manufacturers Association; Prof. T. R. Lawson, American Society for Testing Materials; P. E. Holden representing E. W. McCullough, U. S. Chamber of Commerce; P. H. Bates, Bureau of Standards; Clyde L. Moyer, representing G. F. Schlesinger, American Association of State Highway Officials; R. M. Hudson, Division of Simplified Practice, U. S. Department of Commerce; E. J. Mehren, McGraw-Hill Publishing Co., Chairman.

Edgar Jadwin Nominated as Chief of Engineers

The President, on April 7, sent to the Senate the nomination of Brigadier General Edgar Jadwin, the present Assistant Chief of Engineers, to be Chief of Engineers to succeed Major General Harry Taylor when he retires in June. At the same time the President submitted the name of Colonel Herbert Deakyne for the position of Assistant Chief of Engineers. Col. Deakyne is division engineer, northeastern division, with headquarters at New York City.

Montreal Tunnel Project Opposed

The legislature of the province of Quebec has decided against permitting the incorporation of the Montreal Tunnel and Terminal Co. A bill had been introduced some weeks ago which called for the incorporation of a company to build a tunnel under the St. Lawrence river, but the bill was killed by the Private Bills Committee of the Legislature.

35-Mile Railway in Florida Opposed by Commission

An examiner of the Interstate Commerce Commission has recomended to the commission that the application of the South Georgia Railway Company for authority to construct approximately 35 miles of line from Hampton Springs to Deadman's Bay, all in Taylor County, Fla., be denied, also the proposal to arrange for boat service between Deadman's Bay, Tampa, St. Petersburg and other West Coast points. The examiner's report states that the record shows that the project has not been studied adequately, and he recommends that a competent engineer be employed to prepare plans and estimates covering the construction and maintenance of the harbor improvements proposed.

Persian Government Will Employ American Railway Expert

A copy of the new Persian Railway bill which has been forwarded to the Department of State, specifically provides for the employment of an American railway expert. To such a man is offered $25,000 a year to create and carry out plans for national railway development. This work will be part of the economic rehabilitation of Persia. Since 1922 it has been under the direction of Dr. A. W. Millspaugh who resigned from the position of economic advisor to the Department of State, to become Administrator General of the Finances of Persia.

Outside of narrow gage construction lines in the British oil fields there are but 80 miles of railway in the country. An estimated $5,000,000 income from the government monopolies on tea and sugar is by law, to be used to build the principal railroad systems.

As the plans for each portion of the development are approved by the government, foreign construction companies will be invited to submit bids for the work.

New 23-B.G. Impounding Reservoir for Baltimore, Md.

General plans and estimates have been made and surveys have been started for a dam and 23-billion gallon impounding reservoir (Prettyboy project) on the Upper Gunpowder Falls to afford additional storage for the water supply of Baltimore, Md. For construction purposes, $2,500,000 has been allotted from the $10,000,000 water-supply loan of 1923, for which the Public Improvement Commission of Baltimore is trustee. V. Bernard Siems is water engineer of the city.

Preliminary data for the location of the dam, reservoir and property line were obtained by an aerial survey. By this means the project was considerably advanced before it was brought to public notice.

The plans provide for a concrete masonry dam with a volume of some 91,000 cu.yd. The structure will be approximately 130 ft. high from the spillway crest to stream bottom. The spillway length will be 200 ft. and the total length of the dam at the crest will be about 600 ft., above which there will be a bridge 660 ft. long. The spillway will be at approximately El. 520 above mean tide and the bridge floor at El. 535 feet.

The reservoir will flood 1,700 acres and will have a length of 6½ miles. Out of a total drainage area of some 47,000 acres, about 4,000 have been acquired by the city at an average price of $47.08 per acre, the range being from $8.60 to $88.23 an acre. No towns will be flooded out and there are no railroads to be relocated, but there will be about 8½ miles of new roads to be constructed and at least two highway bridges to be built: one known as the Beckleyville bridge 600 ft. long and the other the Hoffmanville bridge 200 ft. long.

Road Builders' Annual Meeting in May

The annual meeting of the American Road Builders' Association will be held May 14 at the Engineers' Club, New York. Among the most important activities will be the reports of Charles M. Upham, business director of the association, and of President W. H. Connell and treasurer James H. MacDonald. The general meeting will convenue with a banquet at the Engineers' Club on the evening of May 14, preceded by a meeting of the board of directors in the afternoon. At the meeting of the board two directors will be elected to fill vacancies caused by the death of Lewis S. Louer, Chicago and W. H. Stone, Baltimore. New officers to be installed include H. G. Shirley, Richmond, Va. as president; S. T. Henry, Spruce Pine, N. C., as vice-president; W. H. Connell, Harrisburg, Pa., past-president and ex-officio member of the board of directors; F. A. Reimer, East Orange, N. J., R. Keith Compton, Richmond, Va., C. M. Upham, Raleigh, N. C., William Ogden, Cleveland, O., and Frank Torrace, Orillia, Wash., re-elected directors and W. H. Kershaw, New York, and C. M. Pinckney, New York, new elected directors.

Examiners Favor Panhandle Extension in Texas

The Interstate Commerce Commission on Mar. 19 made public proposed reports of C. E. Boles, attorney-examiner, and E. Gray, engineer-examiner, recommending findings by the commission for the construction of new railroad lines in Texas.

The report recommends findings that public convenience and necessity require the construction by the Texas, Panhandle, and Gulf Railroad of a line from Seymour, Tex., to Tucumcari, N. M., approximately 303 miles, at an estimated cost of $7,717,500 provided, that within six months from the date of the commission's certificate, arrangements are perfected whereby:

(1) Control, by lease or otherwise, of the Gulf, Texas, and Western Railway is acquired.

(2) Control or perpetual trackage rights are secured from Paducah to Floydada, Tex., over the Quanah, Acme, & Pacific Ry. This includes a proposed extension of 27 miles from MacBain to Floydada.

(3) Such control of the applicants will in turn be acquired by a major carrier other than the Santa Fe or the Burlington and their subsidiaries. This is to assure proper financing and operation of the proposed line with due allowance for competition.

If these arrangements can be effected it is recommended that lines be built between Floydada and Lubbock, and Floydada and Plainview, the latter to be constructed only in the event that trackage rights cannot be secured over the existing lines of the Santa Fe.

This it is felt would afford a more direct outlet from the territory to Fort Worth, the East, and Southeast, and also provide a thorough route from Tucumcari to Fort Worth.

Applications for somewhat similar developments have been made by the Pecos and Northern Texas Railway (Santa Fe System) and the Fort Worth & Denver South Plains Railway.

To Standardize Water Power Measurement and Data

A convention of the International Electrotechnical Commission is to be held in the Engineering Societies' Building, New York, April 13 to 23. The chief theme of the meeting will be to formulate an international agreement for the measurement of water power and the standardization of water power data.

A John Ericson Medal

An award to be known of as the "John Ericson Medal" has been established by the American Society of Swedish Engineers as a tribute to that prominent engineer who for the past 29 years has been city engineer of Chicago. It is to be awarded not oftener than every second year to Americans of Swedish birth or descent or Swedish citizens as a recognition of distinguished accomplishments in science and engineering.

Engineering Camp to Be Built for Yale Students

The Yale Engineering Association has announced the success of its drive for $78,000 to equip an engineering camp on a 2,000-acre tract already owned by the Sheffield Scientific School at East Lyme, Conn. A donation from the school trustees brings the total amount of the fund up to $101,000.

Spring Meeting of A.S.C.E. to Be Held at Kansas City

The spring meeting of the American Society of Civil Engineers is to be held at Kansas City, Mo., April 14-16. The Wednesday meeting will be given over to the discussion of two papers, one on the relationship of the railroad to modern highway and urban traffic, and one on urban and interurban buses. On Thursday, the city planning, construction and sanitary engineering divisions will hold concurrent meetings in the morning. The remainder of Thursday and Friday morning will be given over to trips of inspection.

Western Society Officers

The list of nominations for officers of the Western Society of Engineers for 1926-1927 is as follows: President, F. E. Morrow, assistant chief engineer, Chicago & Western Indiana R.R.; vice-presidents, Major Rufus W. Putnam, U. S. A.; John A. Garcia, and M. M. Fowler; treasurer, Geo. W. Hand; trustee, E. P. Rich. Members of the Washington Award Commission, Homer E. Niesz and A. L. Rice.

John Fritz Medal Presented to Edward Dean Adams

Formal presentation of the John Fritz gold medal, the highest honor bestowed by the engineering profession in this country, to Edward Dean Adams was made at the United Engineering Societies Building, New York, on March 30. The award of this medal by the Engineering Foundation to Mr. Adams was announced in our issue of Jan. 21, 1926. It was awarded for Mr. Adams' work in connection with the development of hydro-electric power at Niagara Falls.

The presentation was made by Major Fred J. Miller, chairman of the committee in charge of the award. Other speakers were James M. Beck, Solicitor-General of the United States, and Prof. Arthur Edwin Kennelly of Harvard University.

Zoning Appeal at Aurora, Ill., Dropped by Objectors

Applicants for a rehearing on the zoning decision affecting Aurora, Ill., have withdrawn their request. The Illinois Supreme Court, in a second decision in the same case, appears to have reversed itself, thus establishing the right of the city to restrict the erection of business buildings in residence districts. The first decision (*Engineering News-Record*, March 12, 1925, p. 455) declared the restriction unconstitutionally discriminative because it barred new stores in sections already having them. Otherwise, the constitutionality of zoning was not ruled on. The trial court upheld the city.

WINTER STORM DAMAGES LUDINGTON BREAKWATER

The outer end of the government breakwater at Ludington Harbor, Mich., was broken down during the recent severe storms on the Great Lakes. The accompanying illustration shows the condition of the end of the breakwater after the storm had subsided. The breakwater ends in a depth of about 30 ft. of water at a distance of 2,000 ft. from the shore line. The accumulation of ice upon the outer end of the breakwater before it broke down was even greater than the mass shown surrounding the pier light.

WASHINGTON NOTES

RESEARCH on highway problems would be undertaken by the Corps of Engineers under a bill just introduced into Congress by Rerpresentative Connally, of Texas. He proposes that one fourth of one per cent of the money appropriated for roads be turned over to the Chief of Engineers for these investigations.

THE Chelan Electric Co. of Seattle has been authorized by the Federal Power Commission to develop the power resources of the Chelan River. The license will contain conditions intended to protect the scenic beauty of Chelan Lake and its value as a recreation center.

The project involves the construction of a dam across Chelan River at the outlet of Chelan Lake. This will create a head of 380 ft. and will permit the development of 57,000 hp.

AFTER a public hearing at which new data were developed, the Federal Power Commission has returned to the Chief of Engineers for further study his report on a proposed power development in New River near Radford, Va.

The Chief of Engineers has expressed the opinion that the project will not affect navigation in the Kanawha River, which has a large water-bourne commerce. The members of the staff of the Federal Power Commission differ with this conclusion. They think the operating waves will interfere with the handling of the movable dams on the Kanawha and that the abrupt changes in the river stage will make navigation more difficult. The entire flow of New River could be used to advantage by the power company were it permitted to do so.

The staff of the commission has no objection to the project, but thinks the development should come under the water power act so that conditions may be placed in the license. Under the report of the Chief of Engineers the control of the project would rest with the state authorities in Virginia, while those likely to be damaged would be in West Virginia.

Something of an issue is being made of this case as the staff of the commission feels that failure to secure jurisdiction in this case will establish a precedent under which a large number of projects will claim exemption from the requirements of the water power act.

FOLLOWING the appearance before the Joint Committee on Muscle Shoals of representatives of the Union Carbide Co. and of the American Cyanamide Co., some doubt is being expressed as to whether or not any bid will be submitted. It is regarded as certain that no one will propose to manufacture 40,000 tons of nitrogen, as it has become increasingly apparent that any fertilizer manufactured at Muscle Shoals will be at a loss. There also is doubt as to the market's ability to absorb that amount of additional nitrogen at this time.

Engineers to Analyze Plans for Coolidge Dam

A board of consulting engineers has been appointed by the Secretary of the Interior, to pass upon plans and specifications for the new $5,500,000 Coolidge dam on the San Carlos Indian Irrigation project in Arizona. The board includes: Major Gen. Lansing H. Beach, U. S. Army Engineer Corps, retired, of California; Col. William C. Langfitt, U. S. Army Engineer Corps, retired, of New York; and Andrew J. Wiley, irrigation engineer of Idaho.

When this board has complete its work, construction will be started by the Government. The dam has been designed to provide irrigation for 100,000 acres of land in the Gila River Valley in Ariz., 50,000 of which will include lands belonging to the Indians in the Gila River Indian Reservation.

Board of Zoning Appeals Cannot Set Aside Ordinance Limits

The Board of Zoning Appeals of Pittsburgh, Pa., cannot set aside the classification fixed by city ordinance, according to a decision of the local Common Pleas Court. The board overruled the refusal of the building inspector to grant a permit for an 18-family apartment and 18-car garage in a non-apartment district, besides which the proposed building exceeded the height limit. Eight property owners in the vicinity appealed to the court, which on Dec. 30 ruled as has been stated. A decision similar in general principle and effect, in a case arising in White Plains, N. Y., was handed down recently by the New York State Supreme Court.

U. S. Coast Survey Publishes Earthquake Statistics

A report of earthquake statistics for January to March, 1925, has just been published by the U. S. Coast & Geodetic Survey. It is the first of the series of quarterly seismological reports which the survey plans to publish. The quarter registered 230 earthquakes in the United States and adjacent regions. Most important of these was the Quebec earthquake of March 1, which was felt in 18 States of the United States, from North Carolina to Colorado. The most severe was in Alaska (intensity No. 7 of the Rossi-Forel scale). In compiling the statistics, much help was obtained through non-instrumental reports from Weather Bureau observers and private individuals.

Quantity Surveyors Organize, to Meet in Chicago

An Institute of Quantity Surveyors is now being organized by professional quantity surveyors throughout the United States. The initial session of the Institute will be held in Chicago, June 7 to 9. Discussions and work of interest to the construction industry will take place. Mr. G. Szmak, managing engineer of the Universal Engineering Co., Bridgeport, Conn., is in charge of this co-operative movement.

Carrying Out the Major Street Plan of St. Louis, Mo.

(Special Correspondence)

Plans for carrying into immediate effect additional portions of the City Plan Commission's major street scheme promulgated in 1917 were outlined by Robert B. Brooks, director of streets and sewers for St. Louis, Mo., in an address before the Rotary Club on April 1. He pointed out that under the major street plan 84 miles of thoroughfares are to be widened and that the entire estimated cost of program is $35,000,000, of which $8,500,000 will be met by the city and $26,500,000 by property benefited. [For articles on (1) outlining the plan in detail and (2) describing program in its execution see *Engineering News-Record*, July 19, 1917, p. 100 and May 13, 1920, p. 954—EDITOR.]

One of the projects is a street at the Western limits of the city which will be 15.4 miles long and include parts of Davis, Loughborough, Jamison, McCausland, Skinker, Hodiamont, Darby and Goodfellow avenues. The street will touch Broadway at both ends and with that thoroughfare will provide a complete circuit of the city.

Another project is an 80-ft. street to relieve congestion on Grand Boulevard, the new street to be located midway between Grand Boulevard and Spring Ave. and to be carried over Mill Creek Valley by a new viaduct. Grand Boulevard is now the most congested street in the city, carrying the principal north and south automobile traffic as well as the main north and south street car line and bus lines. Theresa Ave. will be widened from 60 to 80 ft. and extended through from Belle Ave. to Easton Avenue.

Western Society to Hold Fifth Annual Convocation

"Highways and Motor Transportation" is the subject of the fifth annual convocation April 21 and 22 of the Western Society of Engineers. An engineering analysis of the highway problem in all its phases is to be made, including present transportation, growth and development, economics, regulation taxation and co-ordination. The idea is to bring together the views of many interests now apparently conflicting, compare them and develop underlying principles that should govern the planning and growth of highways. A dozen subjects for papers are proposed.

Impulse Units Under 2,419-ft. Head to Develop 60,000 Hp.

In the 2-A plant on Big Creek in California on which the Southern California Edison Co. is planning to start construction this spring, there will be two 60,000-hp. impulse wheels, under an effective head of 2,290 ft. (2,419 static). To avoid the use of large diameters in the penstocks that will carry this high pressure, the lower portion of the penstock serving each unit will consist of four pipes. The new plant is scheduled for completion in May, 1928.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Spring Meeting, Kansas City, Mo., April 14-16; Summer Meeting, Seattle, Wash., July 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 10-13, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Philadelphia, Pa., June 13-19, 1926.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, State University of Iowa, Iowa City, June 16-18, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

INTERNATIONAL CITY MANAGER'S ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The National Highway Traffic Association will hold its annual meeting at the Automobile Club of America, New York City, April 30, 1926.

The Illinois Section, American Water Works Association, held its annual meeting at the University of Illinois March 24 and 25. A number of papers were presented for discussion and an opportunity was given the members to see the experimental apparatus at the university, also to visit the plant of the Champaign and Urbana Water Co. and the sewage disposal plant of the Urbana-Champaign Sanitary District. Officers for the new year are W. R. Gelston, chairman, and G. C. Habermeyer vice-chairman. Mr. Habermeyer will hold the office of secretary until a successor is appointed.

Personal Notes

LAURENCE E. WILLIAMS, for the past four years an engineer with the Ohio State Highway Department, has been appointed city engineer of Marietta, Ohio, to fill the position left vacant by the resignation of FRANK H. MAUTZ.

HUGH A. KELLY, consulting architect and engineer of Jersey City, has been made military aide to the Governor of New Jersey, with the rank of colonel. Colonel Kelly has been secretary of the New Jersey Society of Professional Engineers and Land Surveyors since its organization two years ago.

CHARLES DAY, president of the engineering firm of Day & Zimmermann, Inc., Philadelphia, Pa., has been elected a director of the Pennsylvania Railroad Co.

JOHN JEWHURST, city engineer of Lima, Ohio, has resigned to go to Florida where he will be assistant city engineer of West Palm Beach.

B. R. STROUP, until recently assistant division engineer at Orangeburg, S. C., has been promoted to engineer of the Central Division of the South Carolina highway department.

W. W. CROSBY, of Harrisburg, Pa., location engineer in the Pennsylvania Department of Highways, has resigned. He will attend the International Road Congress in Milan, Italy, in September.

W. K. BECKHAM, until recently acting locating engineer and also engineer of the Central Division of the South Carolina Highway Department, has been released entirely from his duties as division engineer and made state locating engineer.

W. H. DITTOE, for many years chief engineer of the Ohio State Department of Health, has resigned to become chief engineer of the newly created Mahoning Valley Sanitary District which has been organized to provide a new water supply for the cities of Youngstown and Niles. Mr. Dittoe will be succeeded as chief engineer of the Ohio Department of Health by F. H. WARING, until now principal assistant engineer of the Division of Sanitary Engineering of the department named.

PROF. HUGH MILLER, dean of the college of engineering in George Washington University, Washington, D. C., has been appointed professor of engineering at Union College, Schenectady, N. Y., where he succeeds Prof. Frank P. McKibben, who has resigned, effective at the close of the school year, to devote his time to consulting practice.

CHARLES R. WATERS, Buffalo, N. Y., has been appointed division engineer of Division 5 of the New York State Department of Public Works, this division comprising Erie and Niagara and three other counties; Mr. Waters will have charge of highway and canal work in the division.

T. J. SKILLMAN, chief engineer of maintenance-of-way of the Western region of the Pennsylvania R.R., with headquarters in Chicago, has been appointed to the newly created position of assistant chief engineer of the railroad for the Western region and will be located in the Chicago office; his successor as chief engineer of maintenance-of-way for the Western region, at Chicago, is W. L. EKIN, who has been superintendent of the Pennsylvania Division at Harrisburg, Pa. Another position of assistant chief engineer for the railroad for the Central region with service in the Pittsburgh office was created and is held by W. D. WIGGINS, who has been chief engineer of maintenance-of-way for the Central region, and whose successor is J. B. BAKER from maintenance-of-way work in the Eastern Pennsylvania region.

JAMES L. TIGHE, consulting engineer, Holyoke, Mass., announces the association with him as partner of PHILIP E. BOND. The practice which each has carried on for twenty-five years in hydraulic, sanitary and municipal work, is to be continued under the name of Tighe & Bond. Offices are at 189 High St., Holyoke.

Obituary

RICHARD H. STRETCH, who under the title of county surveyor had charge of city engineering for San Francisco in 1872 and 1873, died in Seattle, March 22.

GEORGE BENSON, Olympia, Wash., former city engineer, died recently of heart failure. Mr. Benson had been acting as city engineer for Shelton, Wash., and was formerly in the drafting department of the state land office.

GEORGE E. HELLER, civil engineer, Troy, Ohio, who returned to Troy in 1923 on account of ill health, died there recently. He was the first engineer employed by Lake County, Florida, and laid out and planned construction of highways in the county; while there he was president of the Central Florida Engineers' Association.

CHARLES T. PEASE, who at various times was in the engineering departments of the Denver & Rio Grande Southern, the Santa Fe, the Colorado & Southern, and Union Pacific railroads, and for twenty-three years in the government reclamation service, died March 20 at Denver. Mr. Pease was a graduate of the state university of Maine and came to Denver forty-five years ago.

PROF. C. O. SHIVELY, assistant professor of civil engineering at Purdue University, died of pneumonia March 25 at Lafayette, Ind., aged 35 years. After graduation from Purdue University in 1915, Mr. Shively was connected from 1916 to 1921 with the work of the Miami Conservancy District, as draftsman, chief draftsman and assistant division engineer of the hydraulic fill dams at Germantown and Taylorsville. In 1921 he went to Purdue as assistant professor of civil engineering.

MAJ. J. A. B. TOMPKINS, chief assistant United States engineer at Milwaukee, Wis., and for some time consulting engineer to the Milwaukee Harbor Commission, died of apoplexy March 29, at the age of 69 years. Major Tompkins graduated in civil engineering from Rensselaer Polytechnic Institute in 1879. Between that date and 1893 he was engaged variously on harbor and railway work, in Louisiana and Wisconsin; then for one year was assistant city engineer of Milwaukee. In 1894 he became chief assistant engineer in the Milwaukee district and in his thirty years' service had an important part in the building of the harbor and in terminal work at Milwaukee.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

A New Analyzer for Continuous Beams and Rigid Frames

UNDER the name "Continostat," an instrument originated and developed by a Buenos Aires engineer, Otto Gottschalk, has just been introduced in the United States by the inventor. It is being handled by Dr. Albert Gottschalk, Raritan Building, Perth Amboy, N. J. Three views herewith show the construction and application of the instrument. The underlying principle is identical with that utilized in the widely known Beggs apparatus for analyzing statically indeterminate structures, namely, the Maxwell reciprocal principle. The way in which the principle is applied is different, however, in that Mr. Gottschalk uses a flexible steel strip (or a number of them) to represent the beam or other structure to be investigated, in place of the cardboard model of the structure used in the Beggs system of procedure. With the flexible steel strips, the deformations which are measured are large, and can be traced in a curve or measured by scale, as compared with the microscope

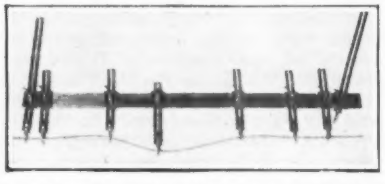


FIG. 1. "CONTINOSTAT" USED TO DRAW INFUENCE LINE FOR (INTERMEDIATE) REACTION OF CONTINUOUS BEAM

Note use of two support arms to represent fixed-end condition.

measurement methods used by Prof. Beggs.

The instrument as represented in Fig. 1 comprises a straight-edge or base member about 3 ft. long, on which a number of claw arms can slide. Several thin steel strips or splines, about ½ in. wide and ranging in thickness from 0.02 to 0.04 in., are provided to represent the beam or the elements of a rigid frame. In a typical equipment three thicknesses of spline are furnished, with moments of inertia in ratios approximately 1:3:6, in lengths from 3 in. to 35 in. By various combinations of these splines any variation of moment of inertia in a beam is represented, using one spline as base and adding reinforcing pieces fastened to it with small spring clips at the points where the moment of inertia is increased.

By direct application of the reciprocal principle, with the apparatus arranged as in Fig. 1, the ordinates of the spline from the base line or original straight position, when the spline is displaced unit distance at one of the supports, give the values of the reaction at that support for a load at the ordinate point; in other words, the deflected position of the spline is an influence line for the reaction at that support. By displacing any one of the supports laterally along the straight-edge, the change of deflection line in all its parts can be followed and the effect upon the distribution of reaction of any

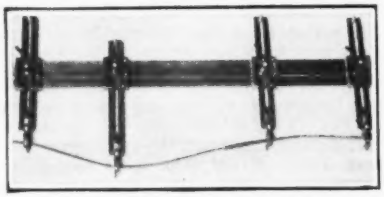


FIG. 2. VARIABLE MOMENT OF INERTIA REPRESENTED BY ADDING STEEL STRIPS TO MAIN BLADE

change in span can be studied very simply and directly. When the beam which is under investigation has variable section, as by bracketing at a support to increase the depth, this may be represented by adding short pieces of steel strips, as in Fig. 2, which changes the influence line quite noticeably from that obtained with uniform spline.

Bending-moment influence lines may be drawn with this apparatus by a special expedient. The inventor found that the angle between the two segments of the moment influence line at its peak, at the point whose moment is shown by the line, is practically constant for all points of the span or beam. He therefore assumes that this angle remains strictly constant, and provides a connector or fixed angle, in which two pieces of spline may be held, and then placed in the claw arms of the "Continostat," as shown in Fig. 3. In

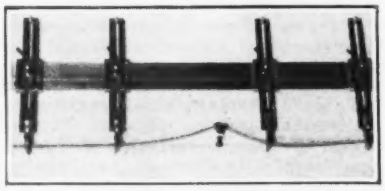


FIG. 3. SPECIAL EXPEDIENT FOR DRAWING MOMENT INFLUENCE LINES OF ELASTIC STRUCTURES

this position the spline traces out a bending-moment influence line for the series of spans, for the point where the connector is applied; by shifting the compound spline lengthwise of the apparatus, bending-moment influence lines for other points of the beam are obtained.

For rigid-frame problems, a spacer arm is provided to hold the lower ends of a pair of columns (represented by pieces of spline attached to the main or girder spline by right-angle connectors) at fixed distance apart. By a proper setting, the condition of fixed column base may also be represented.

Some 40 instruments of this type are said to be in use in different parts of the world, 30 of them in South America and four or five in the United States. Actual manufacture of the instrument dates back only to 1922, although development of the idea was begun four years previously.

Cement Companies Consolidate

Certain cement properties in which the Cowham Engineering Co. have been interested have been brought together under the Consolidated Cement Corporation, capitalizd at $35,000,000. Companies acquired are the Peninsula Portland Cement Co., Cement City, Mich.; the Great Western Portland Cement Co., Mildred, Kans.; the Fredonia Portland Cement Co., Fredonia, Kans. These properties are appraised at $7,500,000 and have an annual capacity of 3,000,000 barrels. The Cowham Engineering Co. will act as operator of all the properties but the product will be marketed under the existing brands. The Cowham Engineering Co. is now building two other plants, the Florida Portland Cement Co., Tampa, and the Central States Portland Cement Co., LaSalle, Ill. These plants and not in the new corporation but John L. Senior is president of all three.

Business Notes

GOULDS MFG. CO., Seneca Falls, N. Y., announces a change in its name to Goulds Pumps, Inc. When the company was incorporated in 1869, it manufactured a wide variety of products, but now specializes on pumps. There is no change in organization, business policy or ownership.

H. M. BRINGHURST, who has been Chicago manager for the Massillon Steel Joist Co., Massillon, Ohio, for the past three years, has been appointed chief engineer and will have his office and residence in Canton, Ohio.

FATE-ROOT-HEATH CO., Plymouth, Ohio, announces the appointment of Lawrence E. Buzard as general sales manager. Mr. Buzard has formerly been assistant sales manager.

KENNERLEY BRYAN, JR., for the past two years district manager of the Cement-Gun Co., Inc., at Pittsburgh, Pa., is now associated as contracting engineer with the Fritz-Rumer-Cooke Co., railroad and general contractors, of Columbus, Ohio.

STREET BROS. MACHINE WORKS, Chattanooga, Tenn., manufacturer of hoists, cableways, derricks and draglines, an-

nounce that R. J. Quinlan is now connected with the company as a sales engineer.

THOMAS ELEVATOR CO., Chicago, announces the appointment of the Day & Maddock Co., Cleveland, Ohio, as exclusive distributors for its hoists in the vicinity of Cleveland.

THOMAS A. RIGBY has recently been added to the Pittsburgh office of the McMyler-Interstate Co.

Equipment and Materials

Flap Gate for One-Way Pipe Drainage

For use in connection with the drainage and protection of streets and roads, river bottom lands, and similar areas which are subjected to the danger of reflooding from backwater, the California Corrugated Culvert Co., West Berkeley, Calif., has developed a cast-iron flap gate. This gate is mounted on double hinges which are operated by

very small changes in the water level. The gates keep the pipes practically watertight when closed. Furthermore, under conditions of maximum outflow, the gates are forced away from the pipe outlet so as to interfere but very little with the capacity of the pipe. The illustration shows five 6-ft. diameter gates installed on a sugar plantation in Texas for flood protection work.

Patrol Grader Operated From Tractor Power Take-off

A one-man power patrol grader with detachable power unit for general road maintenance is announced by the Stockland Road Machinery Co., Minneapolis, Minn. Practically any tractor with a power take-off may be used to pull this grader. Tractor power is controlled from the operator's seat for raising and lowering the blade and scarifier. The machine is equipped with cut gears, oil-tight housings, and the wheels are provided with Hyatt bearings. Each tractor requires a different hitch to the grader, but such tractors as International, Fordson, and Twin City are fitted for this equipment. The weight of the grader alone is 4,100 lb. Blade lengths of 8, 10 and 12 ft. are available all with a width of 16 in. The blade lift above the ground is 12 in. The wheel base is 12½ ft.

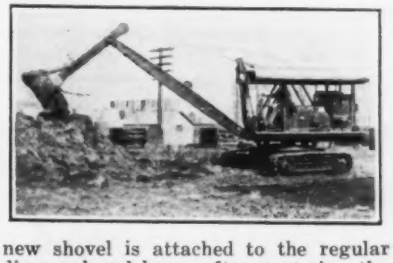
Special-Sheathed Electric Wire Approved for Use

The non-metallic sheathed cable, known as RomeX and manufactured by the Rome Wire Co., Rome, N. Y., which has been a subject of much debate in the electrical industry during the past four years, has finally been approved by the National Fire Protective Association. This action will permit the Rome Wire Co., to begin production of this product and place it on the market in competition with other insulated

wiring now used on all types of circuits under 300-volt potential. The accompanying sketch shows the construction of this wiring. The core or beginning of RomeX cable is a standard rubber covered code wire, marked A in the sketch. B is a close wrap of fibrous tape formed from six thicknesses of long fiber kraft paper. The cotton braid C is then applied and carefully saturated with fire resistant compound. Another wrap D of the long fiber kraft tape is next applied and two or more of the conductors are thus sheathed together with filler cords E under a very heavy braided outer jacket F. The materials marked D, E, and F are all treated with a special compound that makes them fire-proof and moisture-proof.

Trench-Hoe Shovel Attachment Available for Excavator

The ditcher or trench-hoe shovel is the latest attachment developed by the Speeder Machinery Corp., Fairfield, Iowa, for use with its excavator. This

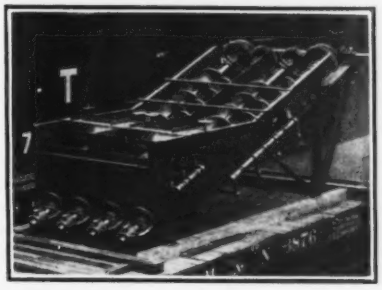


new shovel is attached to the regular dipper shovel boom after removing the dipper and sticks. It is made in various widths, but the 28-in. bucket cutting 30 in. is being the most used. This bucket, of ¾-yd. capacity, has a latch - operated, bottom - discharge door for loading into wagons and trucks. A special feature is the direct inhaul on the bucket, a single line being used. Variation in the hoisting and digging line speeds is possible by lagging the drums; the speed can also, of course, be varied by using the low speed clutch. The ditcher digs to a depth of 16 ft.

New Machine for Washing Concrete Aggregates

To meet the demands of present-day practice which requires that concrete aggregates be free of all coated impurities, the Perfect Classifier Co., Nashville, Tenn., has perfected a new piece of sand and gravel washing equipment. The machine is designed to take the aggregates after they have passed over a screen and give them a thorough scrubbing and scouring and to deliver a practically dewatered product free from impurities. The separation made by this machine is accomplished by a flotation process, using a high water level in conjunction with a scrubbing action of two revolving screws.

The material is admitted to the machine over an adjustable baffle into a bath of water traveling in a direction opposite to the path of the material at



a high velocity and under pressure. The lighter filth, such as sticks, leaves and silt, comes immediately up in suspension and is carried off by the velocity of the water at the high discharge level. The other filth, that which has slight difference in specific gravity as compared to the material to be recovered and the coating of organic impurities that adhere to the product, is deposited through the bath of water and carried forward by the two revolving screws.

During this travel, the heavier filth is given a chance to come up in suspension and pass off at the second draw at the middle of the box. The water is admitted from the bottom and sides of the box under pressure and is sprayed from above the material. The closely adhering coating of filth is scrubbed loose during this travel, coming up in suspension and passing off with the flow of the water. The clean product is carried forward out of the bath of water and deposited through an opening in the bottom of the box at the high end.

The sand machine has a rated capacity of 30 cu.yd. per hour and the gravel machine is made with a capacity of 40 to 100 cu.yd. per hour. Both machines are constructed of steel and iron electrically welded throughout.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

The Real Construction Shortage

Created by a New Plane of Demand

Authorities disagree regarding the building deficit caused by war which was probably eliminated by the tremendous programs of 1924 and 1925.

MANY minds are applying many methods to determining the basic facts of construction volume. The questions to be answered are what is the long-time trend and has the building shortage been made up?

Before giving consideration to these vital questions, a summary of several studies may be of value in gaging the whole problem. H. B. Byer of the United States Bureau of Labor Statistics writes in the Monthly Labor Review that "the line of population increase is the normal line of construction increase." His conclusion is that at the end of 1924 the war shortage had been made up and that construction was four-tenths ahead of current needs. The basis for this study was the value of permits issued in the year 1914. If this conclusion is valid it is particularly interesting to note that the following year (1925) smashed all building records. It would be clear confirmation of *Engineering News-Record's* suggestion (Aug. 27, 1925, p. 367) that the industry is on a new plane of demand.

Colonel Leonard P. Ayers, in Commerce Monthly, November, 1925, estimated that at the end of 1924 there was a shortage which would be made up in 1925. The figures used in this calculation were building permits issued in sixty-six cities, representing probably one-third of the country's building.

Dr. Wilfred I. King bases his studies upon the assumption that building volume is dependent upon population growth and total population. His basic data are permits issued in forty-one cities and the population in those cities, 1910 to 1919. He estimates the normal building requirements to be $859 for the old population and $1,191 for the new. According to the deductions made from this study, on Jan. 1, 1925, there was a shortage valued at $7,000,000,000.

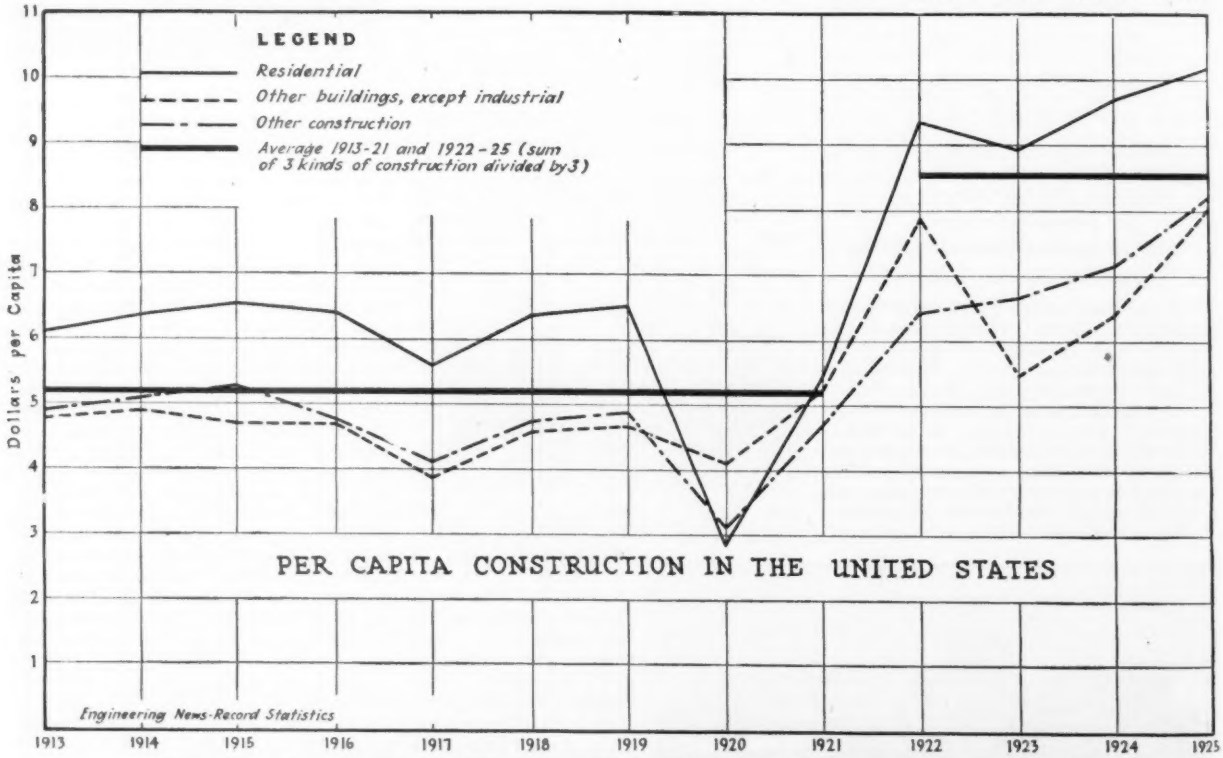
W. C. Clark, of S. W. Straus & Co. states that Dr. King's figures are probably subject to error because his calculations were based on a wholly abnormal period—the decade which included the war years. Using the period 1902 to 1916 he arrives at an estimated shortage of $11,097,000,000.

Thus, authorities disagree as to whether there is a war shortage and, if there is, its size. *Engineering News-Record* believes that this shortage has been largely, if not entirely, eliminated by the tremendous programs of 1924 and 1925. But it also believes that another building shortage exists—a shortage of modern structures.

Both the table and the chart indicate that the country may be upon a new plane of construction demand. The figures have all been placed on a 1913 basis by application of the *Engineering News-Record* Cost Index. The rise in 1922 and the consistency with which the new level has been held are signifi-

PER CAPITA CONSTRUCTION IN U. S. REDUCED TO 1913 PURCHASING BASIS

	Avg. 1913 to 1921	1922	1923	1924	1925	Avg. 1922 to 1925
Residential	$5.55	$9.40	$8.89	$9.72	$10.16	$9.54
Industrial	1.12	2.13	2.14	1.68	2.04	2.00
Other buildings	4.60	7.83	5.49	6.41	8.00	6.93
Other construction	4.61	6.39	6.57	7.11	8.18	7.06
	$15.88	$25.75	$23.09	$24.92	$28.38	$25.53



Showing the Country's Rise to a New Plane of Construction Demand

All Figures Reduced to a 1913 Purchasing Basis

cant. If the remarkable activity in the construction industry is attributable in great measure to changing fashions in building it is worth noting that to bring the construction of the earlier period (1913 to 1921) up to the present standard would require an expenditure of close to $9,000,000,000.

These nine billions represent work in reserve, or in addition to running requirements, and would seem to be sufficient to prevent any serious break in contract-letting. The existence of this potential work goes far to assure a long-time trend that will be fairly flat.

The immediate outlook is favorable to a continuation of present business activity, at least until the middle of the year. Interest rates are low, bank credit is ample for legitimate demand, construction costs are stable, stocks are light and production is regulated.

A noteworthy safeguard against inflation is the ability of the railroads to handle the nation's freight expeditiously. Such reserve stocks as exist are carried by the mills instead of by thousands of dealers. This gives the manufacturers a gage by which to regulate output.

The relative purchasing power of wages, as measured in living costs, is at the highest point reached in twenty years. Employment in the manufacturing industries is greater than at any time since April, 1924.

The recent break in the securities market and the present tendency toward improvement in bond disposals may constitute the first faint indications of impending industrial depression.

The excess of imports over exports during January and February of this year is another adverse factor attracting considerable attention. Installment buying, too, is exerting an unfavorable influence in the general business situation. The growth of this "dollar down" practice is being watched, particularly in the automotive industry, where its effect has already been serious.

Whether there will be a mid-year slump and, if so, how serious it will be, nobody knows. There is, however, a fairly general feeling that some slowing down may happen in the course of several months.

The fact that there are no large accumulations of materials and equipment to be sacrificed in the event of a smaller demand, should have a steadying effect. This effect should be strengthened by the need for billions of dollars worth of new construction if the buildings and public works of the country are to be thoroughly modernized.

This Week's Special Tabulation of Unit Prices

1. Steel Electric Conduit in Place

These unit prices were included in the low bidders' estimate on various sections of New York subways from 1922 to date. The following are for steel electric conduit, per lin.ft.:

Size, Inches	Nov., 1922	Jan., 1924	Oct., 1924	Nov., 1925	Jan., 1926	Mar., 1926
¾	$0.30	$0.50	$0.40	$0.60	$0.40	$0.40
1	.38	.50	.45	.70	.50	.60
1¼	.50	.75	.55	1.00	.60	.80
2	.....	.95	.....	.....	2.00	.....
2½	.....	.....	.....	3.00	.....	3.00

Next Week—Waterproofing for Subways

Prices for Steel in Place

Prices bid for the reinforcing steel and structural shapes in place on some of the big bridge contracts awarded this year are given in the following tabulation:

State	Steel	Quantity Pounds	Price per Pound
Oregon	reinforcing	1,000	$0.0550
Delaware	reinforcing	10,000	.0700
New Jersey	reinforcing	710,000	.0550
New Jersey	structural	8,940,000	.0600
Illinois	reinforcing	1,410,000	.0450
New York	reinforcing	137,000	.0600
Illinois	reinforcing	720,000	.0460
Kansas	reinforcing	114,000	.0600
Washington	reinforcing	505,000	.0500
Washington	structural	2,930,000	.0783
Arizona	reinforcing	179,740	.0500

Water-Works Took 426 Mi. of C.-I. Pipe During First Quarter

Cast-iron pipe contracts in the water-works field definitely specified in *Engineering News-Record* in the first quarter of 1926 total 74,470 tons, or 2,263,770 lin.ft. There were 55 lots purchased by 30 cities in 16 states. The tonnage by sizes are as follows:

Inches	Tons	Inches	Tons
4	2,390	16	1,220
6	10,850	20	12,700
8	15,240	24	7,450
10	300	30	1,500
12	7,420	36	15,400

In addition, there are a number of reports that merely state "extending water mains." The value of the above tonnage is close to $4,000,000. The pipe would cover a distance of over 426 miles.

Wiser Building

FRANKLIN D. ROOSEVELT recently told the New York Building Congress members that "the greatest step that will be taken in construction as a whole in the United States in the next ten years is going to be along the line of better building."

Viewing the epidemic of loft building in the cross streets of Manhattan one is inclined to agree that there is indeed room for better building.

Yet old Madison Square Garden—built only forty years ago—could comfortably have withstood many more frosty winters. And the wrought-iron-framed Tower Building was still a sturdy structure when mounting real-estate values demanded its demolition several years ago.

Mr. Roosevelt speaks of the permanence of construction in Europe. "Over on the other side things don't change so fast."

That is true. Over there they leave the Tower of London, Pisa's leaning tower, and the Coliseum. The grand old structures of bygone ages are given sanctuary by the ancient law of tradition.

HERE in America, ages are not measured by centuries but by decades; and tradition has been diluted by economics. Although the old Garden on Fourth Avenue at Twenty-Sixth Street had acquired a sentimental as well as useful value, after all it had merely been a stage for horse shows, circuses, swimming pools, prize fights and a Democratic Convention. The Roman Coliseum is different—but chiefly because it is older. So old is it that it is of that Union League of architecture whose membership includes the pyramids, the Roman arenas, Stonehenge, and the Taj Mahal. Compared with these, even Kenilworth and the Mouse Tower are climbers.

Of course, New York, too, has its inviolate areas—Central Park, Grant's Tomb, the Statue of Liberty, and Ellis Island, to mention only a few. Compared with these even Brooklyn Bridge and the Woolworth Building are ephemeral.

SOUND building is of course a fundamental engineering principle. But in this changeful decade there can be no building for permanence. We must build for usefulness. The immediate problem of engineers is to measure what usefulness means to a decade of endless change and replacement.

Today the Equitable Building may be the apogee of office construction. But if trade continues to move uptown, leaving to finance and greater commerce the section south of City Hall, it may be that the vast Equitable will find itself to be, in a sense, a monument to an earlier generation of business.

"We who have studied Manhattan," says Mr. Roosevelt, "are beginning to feel that localities on this island are taking on a more permanent character." Information of this nature is of paramount importance. It is not enough merely to record the physical trends of the many trades; it is desirable to foresee where ıey will be centered when New York City has finally set.

ENGINEERS can design for permanence; that is merely a matter of cost. They can build for immediate usefulness, which means shaving expense. The art of engineering is to design such structures aɜ will be useful just as long as they can be maintained.

This is better building because it is wise building. And its application is by no means restricted to a single city. It is universal.

—CONSTRUCTION NEWS EDITOR

Weekly Construction Market

THE present downward trend in wholesale prices gives rise to a situation very similar to that existing at this time last year. The ratio of price declines to advances is now almost exactly the same as that of the first week in April, 1925. Reinforcing bars, lumber, brick, tile, and linseed oil are the main items affected in this week's list of building materials' price changes. While firmness prevails in all of these except linseed oil, price weakness in the minor materials serves to force the general market downward. The principal factor exerting upward pressure upon construction cost at the present time is skilled labor. Were it not for wage advances recently granted building trades workers, construction cost would fall considerably below its present level of 1.1 per cent under April, 1925. Four out of seven important centers report no price changes during the past week on the principal items in the yellow pine market. Telegraphic reports to the Lumbermen's Bureau at Washington dated April 2, 1926, show a drop of $1.50 in 1x3-in. B. & Btr. sap-flat pine flooring and a rise of 50c. per M. ft. in 1x4-in. No. 1 common at Hattiesburg, Ala.; 1x6-in. boards advanced $1. At Jacksonville, Fla., pine boards, finish and flooring declined $1, 2x4s and siding, $2 per M. ft. during the week. Lath, 4-in., is down 50c. at Jacksonville and $1.15 in Chicago, compared with March 26. In the iron market, demand is noticeably slower than a week ago; prices, however, remain firm and unchanged. Steel buying shows increasing activity with production at unusually high levels. Steel prices are slightly firmer.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb	4.50	3.50	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.30	3.38	3.00	3.25	3.77½	+3.20	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	53%	53.6%	51%	54.25%	36%	39.2@51%	45%	59 49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	45.25	54.00	49.20@50.20	53.00	64.00	52.00	55.00	55 00
Concreting Material									
Cement without bags, bbl	2.50	2.35	2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	1.25
Sand, cu.yd	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	1 50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.00	34.00	56.00	+41.00	37.75	34.75	27.00	25.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40	10.50	11 10	12.00	+14.25	12.00	15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0977	.10	.075	....	.075	.....	.10	12
Hollow partition tile 4x12x12, per block	.1112	.0977	.10	.075	+.076	.075	.108	.10	10
Linseed oil, raw, 5 bbl. lots, gal	.83¼	.90¾	1.13	.85	.96¾	1.06	—.96	1.12	—1.10
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	82½	.45@.55	.35@.50	.50	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 1, the next on May 6.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.84). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4@4½ per cent, Apr. 5; year ago, 4½ per cent.

Time loans: sixty-ninety days, 4½@4⅝; four-six months, 4½@4⅝ per cent.

Commercial paper: best names, 4½@4½ per cent; other names, 4¾ per cent.

On April 1, 1926

E. N.-R. Construction Cost Index Number 207.05

E. N.-R. Construction Volume Index Number 240

For Explanation and Details of Indexes Since 1913
See the First Issue of Every Month